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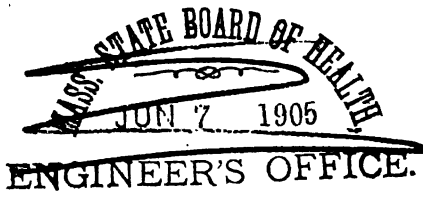
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1902











*Providence, R.I. - Office of the water
commissioners*

MASS. STATE BOARD OF HEALTH,

ENGINEER'S OFFICE.

1873-74.

CITY DOCUMENT.

No. 56.

REPORT
ON
SEWERAGE

IN THE

CITY OF PROVIDENCE,

MADE BY THE WATER COMMISSIONERS AS A COMMITTEE
CONSTITUTED BY THE BOARD OF ALDERMEN
TO CONSTRUCT CERTAIN SEWERS,

TRANSMITTING A REPORT ON THE SUBJECT MADE TO THEM

BY

J. HERBERT SHEDD,

CHIEF ENGINEER OF THE PROVIDENCE WATER WORKS.

FEBRUARY, 1874.



PROVIDENCE:

HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.

1874.

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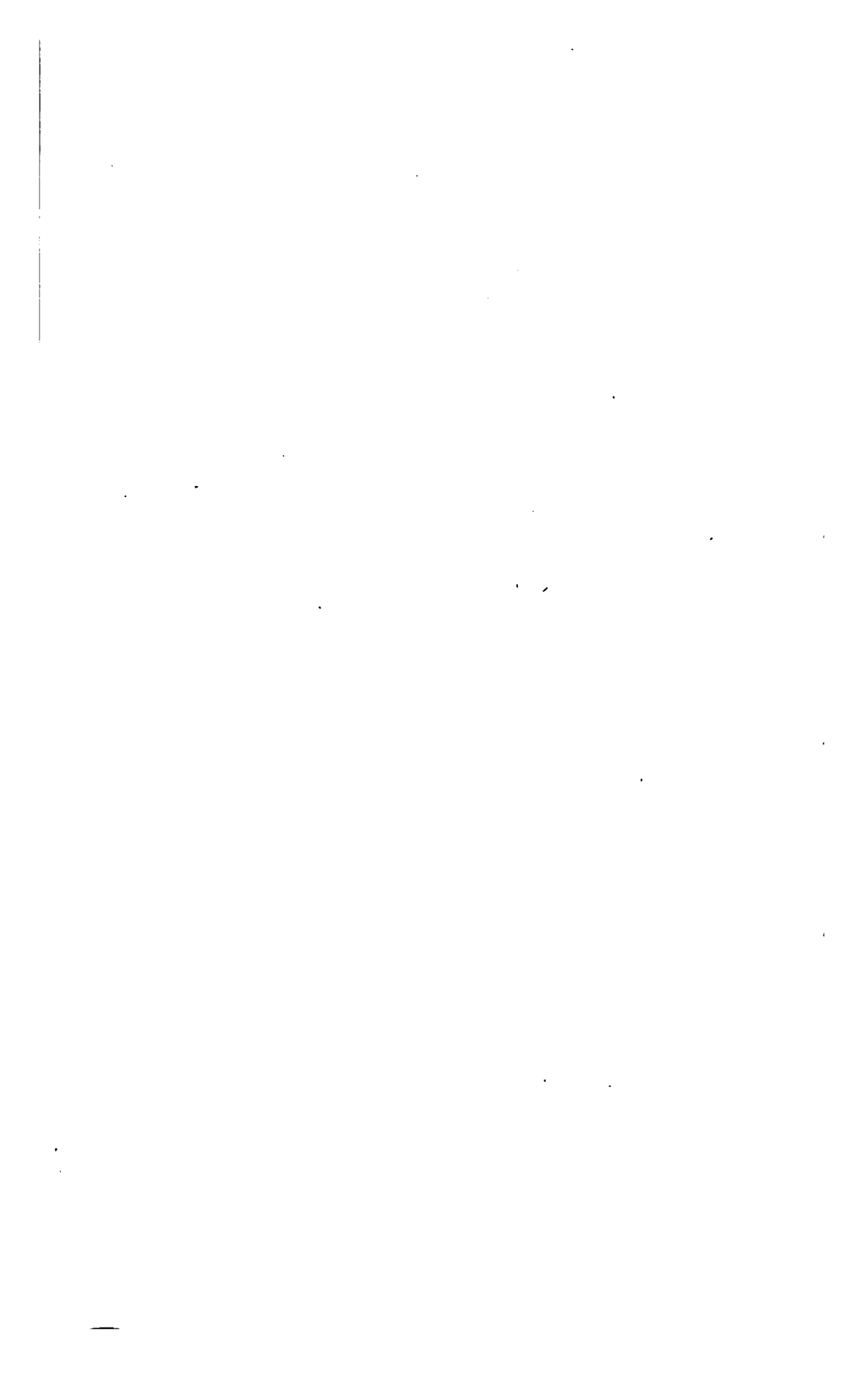
PROVIDENCE, February 19, 1874.

To the Honorable the Board of Aldermen :—

The undersigned respectfully transmit a Report made to them by J. Herbert Shedd, Chief Engineer of the Providence Water Works, embracing the information called for by the following Resolution, passed by your Honorable Body, 26th November last :—

“ Resolved, That inasmuch as the present system of sewerage was adopted by a committee appointed by the board of aldermen, and all the work done by said committee has been carried on in accordance with plans sanctioned by the board ; and the action of said committee has, from time to time, been reported to and approved by the board ; and inasmuch as the work to be done hereafter will be carried on by the water commissioners, under an ordinance of the city council : therefore the committee aforesaid be, and they are, hereby instructed to report in print to this board such information as they may deem necessary to a proper understanding of the general plan on which such sewers have been constructed, together with their reasons for adopting such plan, and also a comparison with the practice of other cities.”

JOSEPH J. COOKE,	} Committee.
CHAS. E. CARPENTER,	
WILLIAM CORLISS,	



SEWER REPORT.

PROVIDENCE, R.I., Feb. 12, 1874.

To MESSRS. JOSEPH J. COOKE,
CHARLES E. CARPENTER, } *Committee on Sewers.*
WILLIAM CORLISS,

GENTLEMEN, — I have received a copy of the following resolution passed by you : —

“Resolved, That the resolution passed by the Board of Aldermen, Nov. 26, 1873, asking the Committee for information in regard to the general plan on which sewers have been constructed, etc., is hereby referred to the Chief Engineer, who is requested to report to the Committee the information which it requires.”

Enclosed therewith was a copy of the resolution of the Board of Aldermen.

In accordance with these resolutions, I respectfully submit the following

REPORT.

An artificial existence must, to a certain extent, arise wherever masses of human beings congregate. Each individual is influenced by the habits and practices of those around him; and the preservation of the health of every class is equally important to all.

Sanitary laws and regulations are intended to give power to communities, which single individuals cannot possess, to promote measures for securing or improving the state of public health; and the extent to which good sanitary measures are carried indicates, in a degree, the state of civilization and refinement.

The modern works of sewerage and water-supply have been experiments made for improving the health and comfort of communities; and it is evident from public records that they have largely accomplished the end for which they were designed.

Three distinct and important objects are to be accomplished by the proper sewerage of a town: —

1st, The ready conveyance of storm-waters without damage to public or private interests.

2d, The efficient drainage of the subsoil and foundations of buildings.

3d, The quick removal of fecal matter and liquid refuse from dwellings.

The disposal of excreta has caused by far the greatest amount of discussion, and difference of opinion, among those who have given special attention to the subject of sanitary engineering. The question, in a broad sense, resolves itself into this: "What is the cheapest and most efficient technical process for rendering human excreta useful, instead of dangerous?" It is generally conceded, now, that no time should be lost in freeing habitations from the dangerous infection of putrefying substances: and the first object must

be to get rid of the sewage in an unobjectionable manner; and the next to utilize it, if possible.

Many methods have been proposed, and adopted, in their turn, for the removal of such matter, and for securing good sanitary conditions.

Some have advocated the plan of burning all the waste products of populous places.

Others have urged the view that air is the best agent for removing these matters, and that the pneumatic system is the proper one to be adopted.

Others recommend earth as the best medium for the removal of all fecal and decomposing matter from habitations.

By others it is maintained that the water-carriage system is the only feasible plan that can meet the varied requirements of a dense population.

Neither of these schemes is suited to the removal of all the refuse matter from houses and other buildings. The liquid filth, which exceeds in amount all the other, cannot well be taken care of by fire, air, or earth; while water is unsuited to the removal of street-sweepings, ashes, and solid vegetable and animal refuse from houses.

The use of any other than the water-carriage system requires the retention of fecal matter, for a time, on the premises, as it can only be periodically removed. The retention of such matter heretofore, in the absence of proper sewerage, has usually been in cesspools, underground, among the houses, into which all the sewage from the house is discharged. In them the filth accumulates and putrefies, until it is at intervals removed by manual labor. They act like immense brewing-vessels, sending up deadly vapors, which have no escape, except back into the house, among the inhabitants. They also frequently leak; and, if any well is near, the water is poisoned. Fevers and many other diseases, especially among children, are certain to break out, and become malignant, if the emanations from such filth exist in the air around dwellings. Not unfrequently the direct

passage of foul liquid from the cesspool to the well is shown by the mass of blackened and offensive earth lying the whole distance between the two; and it is often found that the cold-air passages for supplying house-furnaces have been made foul by the soakage from cesspools.

It is of the utmost importance to do away with such a state of things; and it is not to be wondered at that many plans have been proposed for that purpose.

Those who have advocated the burning of all refuse have not succeeded in getting their plans adopted to any great extent.

The "*Pneumatic Sewerage System*" has been very strongly urged. The following is given, by the advocates, as a general description of the arrangements: "Small iron reservoirs are placed under the pavement of all principal street-crossings, each reservoir being connected by means of small iron pipes with the privies of the houses next to it, in such a manner that no offensive gases can escape; in other words, from every single privy a continuous air-tight passage leads into the next subterranean street-reservoir, without the intervention of any cesspool.

"The pipes are provided, each one, with a valve, to be worked from the sidewalks of the street, so that the communication between each privy and a street-reservoir can be established or cut off at will. These valves remain always hermetically closed, except during a short moment when the privy contents are to be discharged into the street-reservoir connected with it, which occurs during the night, in the following manner:—

"A locomobile steam-engine, working an air-pump, is driven near the small subterranean street-reservoir, to exhaust the air out of it and out of the entire system of main and branch pipes up to the hermetically-closed house-valves, which are then, one after the other, opened and shut again, thus discharging the privy contents, including all gases, into the street-reservoir.

"If the vacuum made in the reservoir and pipe-system is

complete, or nearly so, the mechanical force of the atmospheric column rushing in the moment a house-valve is opened equals that of some thirty hurricanes. In order to maintain this vacuum while a number of privy-pipes are discharged, one after the other, the air-pump standing near the reservoir is kept continually in motion, creating a constant draft, which causes all discharges to fly just into the reservoir, and nowhere else, like so many shots from air-guns.

“The urine, exceeding the solid fæces about eight or nine times in volume, affords sufficient moisture, not only to prevent the excrements from drying or caking, but also to keep the whole mass in so fluid a state, that removal is easy, un-failing, and complete, especially under the above-mentioned powerful blast operating upon it. All the privies and their pipes will thus be every day thoroughly cleaned of solids, fluids, and gases, and be filled with fresh air instead.

“After all the house-valves have thus been successively opened and shut, an operation which practice has shown can hardly be done quick enough, the small reservoir itself is emptied by pneumatic pressure into an hermetically-closed waggon-reservoir attached as a sort of tender to the air-pump carriage. This done, the connecting hoses, by which the movable apparatus communicates with the stationary one under the pavement, are uncoupled, and the locomobile with its tender proceeds to the next reservoir, and then to another and another, until the tender is filled.

“As the particular street-reservoir where this will occur can by practice be pretty accurately known beforehand, arrangements are made, that, when arriving there, the locomobile meets an empty tender drawn by two horses, which changes place with the full one; thus allowing the sewerage operation to go on without interruption, the filled tenders being always drawn away by the horses to a temporary dépôt, where they are decanted by direct hydraulic pressure into air- and water- tight barrels, which are then at once sent like any other goods, by rail or steamboat, to the lands requiring the excellent fertilizer thus collected.”

All this requires very expensive structures of iron, connecting with every house, and a degree of perfection in the operation, which, for any great length of time, would probably prove impracticable.

This plan is comparatively new and untried; while it deals with but a small part of the refuse that must be removed. The scheme is certainly not in a condition to warrant its introduction in this community at the present time.

The treatment of excreta by dry earth has found many advocates. It is stated that this system "is founded on the fact of the deodorizing power of earth; a *given quantity of dry earth* destroying all smell, and entirely preventing noxious vapors and other discomforts. The practical application of this power consists in a reservoir for containing *dry earth*, and in an apparatus for measuring and delivering the requisite quantity, so as to deal with every operation in *detail*." The plan has been successfully used in barracks, hospitals, prisons, and schools; but there are strong objections to its adoption for a large population. The earth *must be dry*, pulverized, and immediately applied. No water can be used, and "any incidental drippings of fluids must be covered and absorbed by dry earth." The earth "should be a clayey loam, friable, and thoroughly dried. No soil must be used which contains vegetable matter." Sand is in no way suitable. "Dr. Ross estimates the total quantity of earth required to deodorize the whole excreta of an adult at $9\frac{1}{4}$ lbs." per day. A cubic foot of dry earth would therefore supply about ten persons one day. If we assume the population of Providence to be equal to sixty thousand adults, there would need to be supplied to the whole city six thousand cubic feet of dry earth each day. At the ordinary depth of soil in this vicinity, I think, a quarter of an acre of land would need to be stripped every day in the year to supply the demand, or ninety acres each year. As there are many rainy days, and much time when the ground is frozen, the difficulties of this operation would be considerable. After having been procured in suitable condition, this earth must be transported to

the city, and its equivalent, with the added impurities, taken away each day.

Some difficulty has been found in keeping the self-acting apparatus in order ; and the opinion has been expressed, that, in large towns, their use is "highly dangerous to health."

After all the trouble, expense, and danger attendant upon this scheme, it deals only with a small part of the refuse that must be removed from dwellings. It has been found, that, "for every pound of human excreta removed under the dry-earth system, there are in every well-regulated establishment about 190 of fluid refuse, which must be otherwise disposed of." Some provision must be made to convey away this fluid refuse ; and, when proper drains are made for that purpose, the extra expense of including the fecal matter will be very small.

During the first two or three days after sewage is deposited in water, the smell is unpleasant, but not dangerous to mankind : after that, putrefaction begins, and the gases given off become deleterious. This interval gives ample time for removal by water-carriage under a good system ; and, if it is not improved, punishment by disease will surely follow.

Many persons object to such a disposal of this matter on the ground that a valuable manure is thus wasted ; but the efforts to save it have heretofore, except under peculiarly favorable circumstances, proved very unprofitable, as well as inconvenient, and often dangerous.

Perhaps the most extensive scheme for saving fecal matter by means of cesspools is that adopted by the French Government, and put in practice in several large cities and places in France. The drains accommodate, as sewage, only rainfall and household water, except the contents of a comparatively small number of public urinals. Night-soil is received into cesspools, and in all cases is carted away from the city, and deposited in appointed places. A certain proportion — as much as finds a ready sale — goes to deodorizing works, and is converted into manure ; but large quantities are still wasted.

Mr. Robert Rawlinson, an eminent sanitary engineer, holding several important commissions in the British Government in that capacity, said, in a discussion before the Institution of Civil Engineers in London in 1865, "With regard to the Parisian sewers, it had been stated that those sewers were made to take away surface-water only, and not sewage. He was sorry to say that that principle had been adopted by the French Government in other cities and places: in Lyons and Marseilles, for instance, the same system was carried out. Large sewers were constructed, with subways for the passage of carts and railway trucks, which received the refuse emptied out by hand-labor: that refuse, if the sewers had been constructed upon proper principles, would have been carried out by the action of water flowing regularly through them." "The Parisians committed the fatal mistake, about the year 1820, of insisting, by ordinance, on cesspool construction. It was recorded that the whole subsoil of Paris was on the point of becoming putrid with cesspit matter, and that the ordinance was passed in consequence. By it all cesspits, as matters of private construction, were abolished; and the construction of cesspools upon a gigantic scale was undertaken, or dictated, by the municipality; and all persons thereafter building hotels or houses were obliged to construct 'hermetically-sealed cesspools' after a municipal or royal pattern, which had been devised by the government engineers of France. Into these cesspools, effete matter from water-closets, grease and washings from the sinks, and other such refuse, was to be discharged. He considered Paris, when he visited it twelve or fourteen years ago, to be, on the surface, perhaps, the cleanest city in the world. Nothing could be more beautiful than the order and cleanliness of its paved streets; but the stench, even in the best houses, was almost insupportable. The possibility of hermetically-sealed cesspools was, therefore, a fallacy."

While the climate of Paris is more favorable to health than that of London, the rate of mortality is higher; indi-

cating that the sanitary works of London are more effectual and perfect than those of Paris.

It does not follow that the water conveyed by sewers, from which fecal matter is excluded, is, therefore, any less impure than the contents of sewers receiving all kinds of refuse. Experience in this country and in Europe has proved that no appreciable difference exists in the offensiveness of sediment taken from sewers which do not, and sewers which do, convey matter from water-closets. Corfield says, "Any one who has examined the sewers of Paris, Lyons, or any other town where the cesspool system is as efficiently and thoroughly carried out as it can be, knows perfectly well that the sewage is just as foul, just as offensive in every way, as it is in the most thoroughly water-closeted town."

The most promising plan for utilizing the manurial properties of city sewage, at the present time, is by surface irrigation; the ordinary flow from the sewers being pumped through pipes to distant fields, and there made to flow over grass lands prepared to receive it.

For the entire success of this plan the climate must be so mild that grass will grow nearly all the year, and a large area of porous soil, not likely to be needed for other than agricultural purposes, must be available within reasonable distance. Garden vegetation is sometimes treated by sewage irrigation.

An object which has thus far been more important than the saving of fertilizing products is in large measure accomplished by this plan; that is, avoiding the pollution of rivers.

It is probable, that for inland towns, and possibly for populous places on small salt-water basins, there will be, before many years, an imperative popular demand for the purification of sewage before its discharge into rivers or harbors. Artificial filtration through earth has been practised for this purpose; and it may be that irrigation for farming-purposes during the season when that is practicable, and filtration during the winter season, can be so combined

as to relieve the water-courses, even in our northern climate. Perhaps some one of the "Precipitation Processes" may prove valuable in this connection.

At present, the amount of impurity from our sewers is so small, when compared with the volume of water in the harbor into which it is discharged, that no great inconvenience will be felt, except where the outlets are at unfavorable points.

The Annual Report of the State Board of Health of Massachusetts for the year 1878 contains a report from Prof. William R. Nichols and Dr. George Derby, in which they conclude, from numerous analyses of the sewage of Boston, that its average value is about one cent per ton; and, from numerous analyses of the sewage of Worcester, they conclude the average value of the dry-weather sewage to be about seven-eighths of a cent per ton.

This whole subject has received, and is now receiving, the earnest and careful attention of many very able minds; and expensive experiments are being carried on upon a large scale in many places. In fact, "nearly the whole civilized world is not only interested in this problem, but directly or indirectly engaged in seeking its solution."* The results, however, are not yet sufficiently defined, I think, to warrant any decided conclusions; and while the sanitary engineer will feel bound to recommend that sewerage works be so constructed, where practicable, that they may eventually form part of a plan for the utilization of the waste products, or avoiding contamination, without great expense in changes, he is hardly warranted in actually executing work, at present, to do more than fulfil the first requirement of a system for the removal of refuse; which is, to get rid of the sewage quickly, in an unobjectionable manner.

This can be most effectually and safely done by the water-carriage system, which provides for the removal of the greater portion of all refuse, and is capable of being combined in one system with the conveyance of storm-waters, and the drainage of the subsoil, and foundations of buildings.

* E. S. Cheshbrough.

Sometimes these objects are accomplished by separate and distinct systems of pipes, or sewers, in the same streets ; but the experience of cities seems to be unfavorable to this plan, and the practice is largely in favor of combining all in one system.

Such a combined system is partially devised, and to some extent executed, in the city of Providence.

Mr. E. S. Chesbrough of Chicago, who has deservedly the highest reputation in this department of engineering, has given the following as the

REQUISITES OF GOOD DRAINAGE.

“To drain a city perfectly, the sewers should be of such size, form, inclination, workmanship, and depth below the surface, as to convey, without deposit or stoppage, to the main outlet, and by means of the ordinary quantity of water used for domestic and other purposes, all the substances that are usually discharged into them from private houses, street-surfaces, and, when not injurious to the health of the men who have occasionally to enter, examine, cleanse, or repair them, all the liquid refuse from manufacturing and other establishments. These requisites are not always attainable at a reasonable expense ; and hence compromises are often resorted to, especially when it is deemed impracticable to raise the funds necessary to carry out a perfect system. For this reason, sewers are often laid too shallow to drain thoroughly the soil beneath the foundations of buildings, and with inclinations too slight to prevent deposits from forming in them.”

The proper position for the “main outlet” must be first considered when a scheme for sewerage is being planned.

“If the sewage is discharged into any stream or body of water too small, or shallow, or sluggish, to deodorize and

neutralize it with sufficient rapidity, it will, sooner or later, become a nuisance that must be abated at whatever cost.

“To avoid or remedy this nuisance, vast sums have already been expended in the construction of intercepting sewers, pumping, irrigating, and deodorizing, and other works, in Great Britain and on the continent of Europe; and the cities of this country are already seriously considering the subject.”

“With all the light at present possessed on this subject, there appears to be no other feasible method of disposing of the sewage of cities, especially in the northern and colder portions of our country, than that of conveying it to some comparatively rapid stream or body of water agitated by winds and waves, and sufficiently extensive to neutralize it. In this connection, a practical question of great importance often arises with regard to what is sufficient to neutralize sewage, or render it innocuous. It will be evident, upon the least reflection, that several elements must be considered. The population of two cities may be equal; but the habits and industries of the two, and consequently the quantity of sewage from them, may be very unequal.

“If the quantity should be the same, the character may be very different in some respects. Fresh and salt water are very different in their capacities for neutralizing sewage, the former being decidedly superior in this respect.

“While small towns and cities often experience little or no inconvenience in disposing of their sewage at first, they become more and more embarrassed with it as they increase in size. The most that has been done hitherto in this direction has been partial and experimental; but the experience of the past is of great value in the planning of new works.

“The results of the grand systems of intercepting sewers, carried out in London and Paris, show clearly that it is possible to relieve, to a great extent, the inhabitants of large cities of the evils of discharging their sewage into receptacles from which it is sent back to them through the air. And yet the outlets of those intercepting sewers are com-

plained of; showing that the nuisance, while removed from the many, is imposed upon a few. For this reason, various schemes have been proposed, and some experiments made, to remedy the evil altogether; but thus far only a small portion of the sewage of either city has been disposed of except by discharging it low down into the Thames or the Seine." *

The main outlets in the city of Providence have been arranged, so far as seems practicable, to discharge the sewage into the river or harbor as much below the drained district as possible. It is supposed that eventually one or more main intercepting sewers will be required on each side of the city to collect these outlets, and discharge their flow at points still less objectionable. The present locations of the outlets of the new sewers are reasonably satisfactory, except in the case of the Dorrance-street sewer, which empties at the head of the dock. Some provision ought soon to be made, either to extend this sewer to the end of the pier, of its present size, or to lay a smaller outlet, which might be of cast-iron pipe, to take the sediment and ordinary liquid filth into deep water, while the storm-waters continue to discharge at the present outlet.

DRAINAGE DISTRICTS.

The total area of land within the corporate limits is about 6,014 acres, as taken by scale from the city maps, or about nine and four-tenths square miles.

The Woonasquatucket River and the Providence River separate this area into two natural divisions, known as the "East Side" and "West Side." The Moshassuck River cuts off a portion of the East Side, making a small division, which includes "Smith's Hill."

The drainage of each of these natural divisions has been considered separately, except that a portion of North Provi-

* Report of E. S. Chesbrough to the City of New Haven, Dec. 30, 1872.

dence, near Olneyville, has been taken into consideration in planning the drainage of a portion of the West Side.

Subdivisions, or "drainage districts," are naturally made in the larger divisions by the contour of the ground; and the drainage for each of these districts may be considered separately, except that the outlets or main drains must be planned in connection with those of other districts which have the same final discharge.

Not all the districts, however, are such as would be formed naturally by the contour of the ground. In some cases, intercepting drains have been planned to divert the drainage into new channels.

Where a drainage district lies partly within, and partly without, the city limits, the whole area is, of course, considered.

The general extent and location of the districts, which, for convenience, have been designated by letters of the alphabet, may be seen by reference to the map which accompanies this Report. The limits represented are liable to change in some places, after more complete and accurate information has been obtained. For a portion of the territory, the drainage districts have not been sufficiently defined to warrant representation.

It is regarded as of sufficient importance, at the present time, to construct the sewers, where practicable, so as to keep the ordinary sewage flow out of the Woonasquatucket River and the Cove Basin. This requires a portion of the sewage of district P to be carried a long distance, as will be noticed by inspection of that district on the map.

It is not proposed to construct the main sewers of this district large enough to take all the water from the greatest storms, but to provide, at intervals in the line, for the overflow of storm-waters into the Woonasquatucket River or into the Cove Basin. When the rainfall is of small amount, it is generally loaded with impurities; but the later run of a heavy rainfall is comparatively pure. With the main sewers large enough to take all the rainfall of ordinary storms,—

the limit of quantity to be carefully determined, — and, of course; capable of taking, to the same extent, the first run of water from the heavier storms, the excess of that which comes later may safely be allowed to overflow into the natural channels. This can be accomplished by weirs properly placed, and discharging into drains which lead to the natural water-courses.

The greater portion of the rainfall on district Q, if it should run on the natural surface or on the established grades of the streets, would flow into district P, where the grades of the main sewers must be so flat, that a much larger size of drain would be required to carry the same amount of water than would be required on such grades as can be obtained on an intercepting sewer in district Q.

The objection to large sewers in district P is not simply that they would be more expensive in themselves, but the land all along the Woonasquatucket River would need to be filled higher than will be necessary with smaller sewers.

The height of the outlet, which is through Dorrance Street, is fixed by low tide in the harbor; and the grade of the main sewer will be one in a thousand, which is about five feet in a mile, and is regarded as the lowest allowable in that place. The tide will ebb and flow in the sewer for about a mile of its length.

Probably it will be best to make connection between the Woonasquatucket River and this main sewer at some point near the junction of High Street and Broadway, for the purpose of flushing the sewer with river-water when necessary.

A large portion of the territory enclosed by Providence River, Ship Street, Eddy Street, Cove Street, and Exchange Place, about forty-eight acres in extent, on which, probably, the most expensive buildings in the city stand, is only from $3\frac{1}{2}$ to 7 feet above mean high tide. When the sewerage system is complete, and the waters of a rainfall are gathered quickly, and carried rapidly to the outlet, there will be trouble enough with the drainage of this low district, if we keep out of it all the water that it is practicable to turn in some other course.

With this object in view, an intercepting sewer has been constructed from Atwell's Avenue, through Bourn, Jackson, High, Chestnut, and Elm Streets, to Providence River. This diverts the drainage of about two hundred and seventy-four acres, which would otherwise flow into the low district above defined.

I recommend that a similar intercepting drain be planned, to take the drainage from district Q, through a new street to be laid out from the junction of Ridge Street with Atwell's Avenue, to Acorn Street, where the extension of West Exchange Street would intersect that street, and thence to West Exchange Street as now laid out. The attention of the Board of Aldermen has been called to the need for this street, and the ground has been examined by their committee on streets. The drainage of an area of about one hundred and ten acres, extending from the Dexter training-ground to the new street, would be diverted by this drain. The proposed location for the street is indicated on the map by dotted lines.

The construction of these intercepting drains will probably be favorable to any future scheme for the utilization of the sewage.

They furnish also an element of safety, as the volume of rainfall is brought more under control than would be the case if it was allowed to flow into the lower districts.

The drainage of the Ninth Ward is a difficult problem. Much study has been given to it; but the conclusions are not yet very definite, except as to the lines desirable for the trunk sewers. As these lines are generally through private property, the attention of the Board of Aldermen has been called to the matter, with the suggestion that streets be laid out to accommodate the sewers on portions of the main lines. Further action by the Board is desirable before the plans are proceeded with. The three principal lines of drainage judged to be desirable are as follows: First, from Public Street, between Broad Street and Prairie Avenue, to the junction of Colwell Street with Prairie Avenue; thence on Colwell Street to a point in line with Ocean Street con-

tinued; thence through the junction of Plain Street with the Old Stonington Railroad location, across Eddy Street, and along Old Maid's Cove to Sassafras Point. Second, from Public Street, between Mashapaug Street and Austin Street, running southerly, parallel to Hamilton Street, to a point in line with the continuation of Gallatin Street; thence, in said continuation, westerly about five hundred and fifty feet; thence southerly, parallel to Hamilton Street, to Roger Williams Avenue; thence easterly, in said avenue, to the Old Stonington Railroad location; thence north-easterly, in or near said location, to the first-named main line of drainage at Plain Street. Third, from Maiden Lane, near the location of the New-York, Boston, and Providence Railroad, running south-easterly, in or near said location, to a point in line with Bartlett Street continued; thence in said line of Bartlett Street to the second-named line of main drainage.

The proposed locations of these lines are indicated on the accompanying map.

A much less expensive main sewer could be constructed from Roger Williams Avenue to the outlet at Sassafras Point, if it were allowable to turn the excessive storm-waters through the brook into Cunliff's Pond; but I am advised by the City Solicitor, that, in his opinion, this would give rise to expensive litigation and damages, and that the cost of taking all the waters on to the outlet had better be incurred.

SIZE OF SEWERS.

The practice of apportioning the size of sewers to the work they have to do, seems, as a general rule, to be comparatively recent. The only rule appears to have been to make a difference between the sizes of mains and those of laterals, and to get them all large enough.

The first sewers were probably streams, or natural brooks, running through the town, and covered over to fit them to take the overflow from the cesspools, as well as the rain-water from the streets.

The famous Cloaca Maxima of Rome was employed to carry fecal matter as well as storm-waters; while, on the other hand, it was in England, until within sixty years, a penal offence to turn cesspool matter into the public sewers. And the first act making it compulsory to drain houses into sewers was passed in 1847.

When the covered brooks failed to give sufficient drainage, and became foul from deposits, large sewers were planned for the surface-water and sewage; and, with the idea of the bed of a natural stream in view, it was thought necessary to make all the main drains large enough for a man to pass through them, and keep them clean. "Vast numbers of these great main sewers still exist. Into these sewers all the smaller house-drains were to enter, and the surface-water through the street-gratings as well. The ordinary water used for domestic purposes, and the occasional rainfalls, were relied upon to flush those large main sewers; but their great size made this an exceedingly difficult and uncertain process, and they, in fact, became only cesspools elongated. In dry weather, the filth was retained in them to such an extent, that, after heavy rains, chemical analysis showed that the water which was discharged contained frequently twenty times the amount of human fecal matter per gallon more than it did in dry weather. This state of matters, added to the fact that long-continued dry weather was always attended by an increase of deaths from typhus and other fevers, clearly showed that something more must be done. A further step was then taken by sanitary engineers. The idea of men passing up the drains was set aside, and the smallest possible drains were constructed, until these have arrived at such dimensions as an 18-inch main drain for a town of 10,000 inhabitants. The rainfall was still to be relied on to a certain extent for flushing purposes; but a supplementary assistance was to be given at some points by flushing with water from the ordinary regular supply of the town."

In order to be "self-cleansing," sewers must be adapted, in their size and grade, to the amount of sewage they have to

carry. If the ordinary run of water is spread thin over a broad surface, the scouring effect is lost, and deposits will occur; but with the same amount of water gathered in a narrow channel, and running deep, — the best sectional form being semicircular, — the scouring effect is greatly increased, and the sewers are likely to keep themselves clean.

An experiment in Upper George Street, in London, was made in the main line of sewer, which is 5 feet 6 inches high by 3 feet 6 inches wide, by laying a 12-inch pipe on the invert, and building a head-wall at the end of it, so that the whole of the sewage discharged by the collateral sewers was forced to pass through the pipe.

“The velocity of the stream in the pipe has been observed to be four and a half times greater than the velocity of the same amount of water on the bed of the old sewer.” “The superficial velocity of the water in the pipe is generally three, four, and five times greater than the superficial velocity which obtained under the same circumstances in the original sewer; and the velocity of the whole mass of water in the pipe approximates much more to its surface velocity, as ascertained by a float, than does the velocity of the whole mass of water in the sewer approximate to its own surface velocity.”

The recognition of this principle of the increase of velocity by the concentration of the sectional area of the flow was largely influential in causing many engineers to abandon the idea of cleansing sewers by sending men into them to do it by hand. They relied mainly on flushing the sewers by dashes of water in great volume, aided by some means of stirring up the deposit previous to and during the rush of water.

Perhaps it was natural for men who had set up a new system, which they felt called upon to defend against the attacks—often hot and persistent—of those who adhered to the old system, to push their theories to an extreme, and adopt plans almost as bad in an opposite direction as those they sought to supersede. The “Pipe-and-Brick-Sewers war” had, I think, the effect to cause such results in a few cases; but the middle course is now very generally adopted,

and sewers are more nearly suited to the work required of them. The result is a great decrease in first cost, and a still greater decrease in the proportionate cost of maintenance.

Some of the old sewers of Europe are of enormous size; and at the present time it is not uncommon in Paris to take visitors on excursions through the principal sewers in boats. The sewers bear the same names as the streets above them; and the house-connections are numbered. Foot-paths and rails for carrying-wagons are used, and water-pipes and gas-pipes are enclosed in the drains. The old sewers were not so large as the new; but "the smallest section ever built, under either the old or the modern system, was 5 feet 6 inches high by 2 feet 3 inches wide at the springing of the roof." It will be remembered that these sewers are for surface-water only. The cost of cleansing these sewers is very great.

From a paper on the Drainage of Paris, read before the Institution of Civil Engineers in London in March, 1865, it appears that the cost of cleaning amounts to about £30,000, or about \$145,000, a year, on a length of 217 miles, including the pay of twenty-three officers and four hundred workmen. At that rate, the cost of cleaning the sewers of London would have been about \$870,000 per year. In the discussion upon the paper, Mr. W. Haywood said of the sewers in Paris, "He had ascertained that about three men were required to every two miles of sewers, these men being entirely engaged in helping to keep that length of sewer clean; and the total cost for wages, superintendence, lighting, clothes, &c., he believed, was about £100 per mile per annum: while in London the whole cost of cleansing the sewers, including the expense of water for flushing and the labor bestowed upon their interior, and also of keeping the gullies and ventilating-shafts in condition, — which in the city, owing to the enormous traffic, was a work of considerable labor, and a heavy item of expense, — was about £40 per mile per annum. But, though the sewers in the city were kept clean, they were undoubtedly not in such a state in that respect as the sewers of Paris."

The 1,300 miles of old sewers in London were certainly not models for a system of self-cleansing sewers. Mr. Robert Rawlinson said of them in the same discussion, "Many miles were in ruins, and choked with filth to such an extent, that no ordinary application of water could remove it; and which, at great labor and expense, had now to be removed by shovels." But the size and shape are so much nearer what is required for the ordinary flow of sewage, as to keep the cost of cleansing, even under such serious disadvantages, at two-fifths the cost of cleansing the sewers of Paris, which are understood to be in excellent condition.

The Croton Aqueduct Board use the following language in their Report, dated Jan. 3, 1870: "The system of sewerage which has been adopted by this Board was recommended by the former chief engineer, Mr. Craven (after an experience of nearly twenty years as chief engineer of this department), and was determined on only after a careful study by him of the systems advocated and adopted in Europe, and especially in London, where the subject of thorough and economical drainage had been extensively discussed and experimented on. It has worked well where it originated; and has, as far as we have experience, without exception, worked well here.

"The Board are perfecting and extending the new system as fast as a just economy will allow, and correcting the old arrangement of sewers, which were built without their control, and without any harmonious plan.

"The cost of brick sewers, as built under the old plan, would be about three times that of the pipe sewers, which are their efficient substitute.

"In the matter of cleaning and repairs, the discrepancy is still greater.

"There are now upward of 60 miles of the pipe sewers in operation in this city. Instances of failure have been extremely rare; and in all cases they could be traced directly to unfaithful construction on the part of contractors,—a contingency from which no works are exempt.

"The cost of repairing all of these defects in 60 miles of this sewerage has not exceeded \$3,000; and for cleaning, and removing obstructions, for the past year, the cost has not exceeded \$500.

"There are 261 miles of brick sewers in the city, for which the cost of cleaning, and removing deposit, for the past year, has been \$27,730; showing that, while the extent of the brick sewers is only $4\frac{1}{2}$ times that of the pipe sewers, the cost of cleaning has been more than fifty times greater."

The size of the pipe sewers is indicated in the Report for 1865, where it is shown that about five-sixths of the sewers planned for eight drainage districts "will be vitrified stoneware drain-pipes of from 12 to 18 inches internal diameter." I have the dimensions of only two of the outlet sewers of the system adopted by the Croton Board: that of sewer district No. 3 was 10 feet wide and $5\frac{3}{4}$ feet high in the clear; and the outlet of district No. 5 was 8 feet wide and $5\frac{1}{2}$ feet high in the clear.

From the Report of the Chief Engineer of City Works of Brooklyn, dated Jan. 1, 1873, I find that the total length of sewers laid in that city is about 232 miles, of which about 188 miles are pipe sewers, and about 44 miles are brick sewers. About 120 miles are only 1 foot in diameter; and about 78 miles are from 15 inches to 24 inches in diameter inclusive. The largest size—of very short length—is 10 feet in diameter.

I do not clearly understand the tables in regard to the cost of cleansing. Apparently the whole expenditure for "cleaning and repairing" is \$26,746.70. I suppose this to include cleaning catch-basins as well as sewers, and repairs upon the sewers and appurtenances; also expense of inspection of house connections other than salaries.

From the Report of the Chief Engineer of the Board of Public Works of the City of Chicago, dated May 30, 1873, I find that the total length of sewers built previous to April 1, 1873, is about 170 miles, of which about $53\frac{1}{2}$ miles are 1 foot in diameter, a small amount is 15 inches in diameter,

and about $55\frac{1}{2}$ miles are 2 feet in diameter. The largest sewers are 6 feet in diameter.

The cost of cleansing the sewers for the year ending April 1, 1873, was \$13,606.80: the length requiring to be cleaned was about $48\frac{3}{4}$ miles. The average cost of cleaning by flushing was \$2.25 per 100 feet, and by chain machine \$12.54 per 100 feet. The grades, upon the whole, are nearer level than in any other city in this country with which I am acquainted.

The city of Chicago was the first in the United States to use pipe sewers on a large scale. Mr. Chesbrough, Chief Engineer to the Sewerage Commissioners, visited Europe in 1856-57, and made careful and extended observations of the systems in operation there, which confirmed his conclusion that the plan to use pipe sewers was advisable. He says in his Report, dated April 1, 1861, —

“At the time our sewerage plan was adopted, a warm controversy was going on in England between the advocates and opponents of pipe sewers. They had never been used to any extent in the United States. It was difficult to know what to decide upon, as the accounts from England, not only with regard to opinions, but actual results, were so conflicting. It seemed evident to us, that if properly constructed, and not applied to drainage areas too large for them, they might be safely adopted. The experience of nearly five years confirms this opinion, and shows that they not only cost less money than large brick sewers would have done in the first construction, but are likely to cost materially less in maintenance.”

Pipe sewers are now in general use through the country.

WHAT DETERMINES SIZE.

The capacity of sewers to carry water depends mainly on their sectional area — if of proper form — and the rate of fall. In order to render sewers as nearly self-cleansing as possible, they must, as before stated, be adapted, in size and inclination, to the ordinary flow of sewage, so far as to keep

up a velocity sufficient to carry on all light matters, and to leave only so much heavy matter as will be finally carried along by the scouring effect of the storm-waters.

But the ordinary flow is a very small part of what must be taken care of in time of storm. The sewers which have been recently constructed in this city are designed to carry about sixty times as much water as the average ordinary flow of sewage would amount to from a population of 32,000 persons per square mile ; and, in providing a sufficient capacity to take this amount of storm-water, the channel for ordinary flow is necessarily such as to cause more frictional surface, in comparison with the volume, than is desirable, especially on sewers of small inclination. This disadvantage is not so great, however, in the modern egg-shaped sewers as in other forms.

There is room for question as to how far the sewers should be made capable of carrying extraordinary storms. The original cost of large sewers, as well as the cost of maintenance, is so much greater, that a city can afford to pay for damages done by storms of unfrequent occurrence, rather than to construct them. Just where to stop in providing for such storms is a matter of doubt ; and what would secure true economy in one place would not necessarily do so in another. The frequency of the heavy storms, the amount of rainfall, and the damage likely to be done, depend upon the location and the circumstances of each place.

In the Report of the Engineer to the Commissioners of Sewerage of the City of Brooklyn, on the General Drainage of the City, made in 1859, the following language is used :—

“ With reference to the amount of rainfall to be provided for, no system of sewerage yet proposed in any city contemplates the removal of *excessive* storm-waters by means of the sewers alone,—such storms, for instance, as discharge for short intervals two or three inches of rain in the hour. They occur at long intervals, and are of short duration, and the damage is usually confined to limited areas ; whilst the construction of sewers to meet the contingency would be

attended with an enormous expense over the whole city both in construction and repair, and of doubtful efficiency when suddenly called upon, and extremely objectionable as conduits for the ordinary flow of sewage."

The conclusion arrived at in Brooklyn was to provide for a storm of one inch in depth per hour, but to assume that not more than half this quantity would reach the sewers during the time of falling, owing to various losses, and to the time required for the water to flow over the surface before reaching the sewer. Col. J. W. Adams was the engineer who determined the plan of sewerage, and who made the report above referred to. When a full description of the works was made in 1865 by Mr. James P. Kirkwood, engineer, he gave a formula to express the practice, which gives sizes slightly smaller than the sizes employed in this city for similar areas and inclinations.

It appears from Col. Adams's Report to the Commissioners of City Works of Brooklyn, dated Jan. 1, 1873, that, during the excessive rain-storms of the previous summer, much complaint was made of surcharged sewers in some localities. Though a considerable portion of this was due to imperfect work on the private drains, and to peculiar circumstances, yet it was in large measure owing to the size of the sewers having been proportioned to a discharge of one inch of rain in an hour. To meet these excessive storms, three shallow storm-sewers were proposed, at a total expense of \$50,000, to give such relief as was needed.

It is common, and according to the best practice, in this country and in England, to provide for a rainfall of one inch in an hour.

To ascertain the frequency of such storms, I have had a careful examination made of records kindly loaned to me by President Alexis Caswell, D.D., LL.D., who has kept a very full meteorological register, since 1831 to the present time, in this city.

I give on the following pages a portion of the information obtained in this way, selected and arranged to illustrate this subject.

The following table gives the number of storms in each month of each year, classified according to the amount of rain, so that storms yielding an amount nearest to any given tenth of an inch in depth are collected together. The number of storms is given opposite the month, and under the respective depths.

1832.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rain greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January	2	1			1	1				1					1						23
February	1		2	3			1	1		1											
March	2	1	2	1			1								1						
April	2	1				2												1			
May	2	2			2	1															
June	2	1																			
July	2	1				1			1												
August	3	1		1		1		1							1						
September	1			2				2			1										
October	1			1			1			1											
November	1						1					1					1				
December	1	1	1	1				1											1		21
Total number	16	8	5	9	3	8	3	4	1	3	1	1			3	1		2			2

1833.

January	1						1			1											26
February	1					1					1										
March	1	2	1	1				1													
April	2	1			1																
May	2	2		2	1	1															
June	2	2			1			1													
July	1				1			1													
August	2	2		2						1											
September	2	1	1	1		1															
October	1		1						1	1		1	2								
November	1		1	1					1				1				1				
December	1	1			1	1	1	1											1		
Total number	11	9	4	8	5	3	3	3	2	3	1	1	3			1			1		2

1834.

January	2	2	1					1													26
February	1		3		2																
March	1		3	1																	
April	1	2		1	2		1	1													
May	1						1	1													
June	2	1			2	1							1		1						
July	2					1													1		
August			1	1	1																
September	1	1		1		1		1												1	
October	1		2										2				1				
November	3		1																		
December	2		1							1						1					
Total number	12	9	7	4	7	3	2	4		1			3		2	1			2		3

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1835.

	DEPTHS IN TENTHS OF AN INCH..																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January			5			2				1											24
February	1		1						1												
March			2		1	1		1			1	1									
April	1	1	2		1			1	1			1									
May	1	1				1		1													
June	2	2		1	2																
July		2	1			1											1				
August	1	2		1												1					
September	1				1																
October			1			1															
November	2	1				1	1														
December													1				1				
Total number	9	9	13	2	5	7	1	3	2	1	1	2	1	1	2						1

1836.

January			1	1	1	2		1													25
February	2		1	1				1										1			
March	1	1			1		1							1						1	
April	2			1													1				
May		1				1	1			1											
June	2	1	1	1	1			2													
July	2	2	1	2																	
August	3	1		1																	
September	3			2																	
October	1	1							1	1											
November	1	1							1	1	1		1				1				
December	1									1	2	1									
Total number	18	8	4	9	3	3	1	2	3	2	4	2	1	1	1		2	1		1	1

1837.

January				1					1												21
February	1		2					1					1								
March	2							1						1							
April					1		1		1						1				1		
May	1	1	1	2	1		1		1						1						
June	1				1		1			1	1										
July	2	1			1	1															
August	1			1	2				1												
September	1																				
October				1					1												
November	1				2				1										1		
December							1														
Total number	9	2	4	6	5	2	3	2	5	2	1		1		1	2		1	1		1

1838.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than sixteens.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January			2							2											21 32
February	1		2		1	2															
March		1			1					2											
April		2	1	1			1			1											
May	1	1	2	1	1						1										
June		2	1			1	1								1						
July	2	3																			
August	1				1				1												
September		1	1	1		1			1					1							
October	1	2		2			1			1						1					
November	1	1		1							1									1	
December	1	1				1															
Total number	7	13	10	6	4	5	3		2	6	2			1	1	1				1	2

1839.

January		1				1															25 22 22 30 26
February		2	2			1															
March			1										1								
April	1		1	2																	
May		1	1	3					1												
June		1	1	1		1			1												
July	2	1	1			1		1			1										
August	1								1	1											
September					1									1							
October			1						1												
November				1					2												
December		1						1		1				2							
Total number	4	7	8	7	1	4		2	3	3	2		1	1	2						5

1840.

January	1	1					1										1				24, 22
February					1			1		1						1					
March		1							1							1					
April			1										1					1			
May			1		1		1		2												
June			1					1													
July		1	1			1										1		1			
August	1		1	2						2											
September			3						1												
October		2	1			1															
November	1	1		1	1			1		1		1			1						
December	1	1	1				2				1										
Total number	4	6	10	3	4	1	2	6	1	5	3	1		1	1	3	1	2			3

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1841.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January		1					2	1	1			1								1	33
February			1										1								
March		1	3					1		1											
April		1	1			1		1		1								1			
May	1		1		1								1								22
June		1	1		1									1							
July	3	1	1			1												1	1		
August		1	1								1				1						
September			1				1							1							25
October							1														
November		2		1		1		1		1				1							
December	2						2					1	1						1		3
Total number	6	8	10	1	2	3	6	4	1	3	1	2	3	3				2	1	2	

1842.

January	1		2				1														45
February	2							1	1					1							
March		1		2			1		1												
April		1		1		1	1														
May	3					1	3			1											
June		2	2			1				2									1		
July		2				2															
August		1	2	1				1					1								
September				1					1												
October				1				1													
November		1	1	1				2		1											
December		1				1	1			1			1								
Total number	6	4	9	3	5	6	6	5	1	6	1		2	1					1	1	

1843.

January			1	1																	22
February			1			1		1		1	1										
March	1					1		2													33
April			1	1			1			1										1	
May				1											1	1					21
June			2					2													
July	1		1												1						
August			1			1													1		
September				1														1			
October				1							1	1					1		1		
November		1	1					1													
December		1	1						1						1						3
Total number	2	2	9	5		2	2	4	1	3	1	1	2		3	1	1	1	3		

1844.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Water above Low Tide.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January		1				1				1											25
February			2	1						1											
March			1		2			2												1	
April	2				1																
May	2	1	2		2																
June		2																			
July					1	1	1			1							1				
August				1			1														
September			1			1			1	1											
October						2							1	1					1		
November	1		2							1						1					
December		1	2		1			2													
Total number	5	5	10	2	7	5	2	5	1	5			1	1		1	1		1	1	1

1845.

January		1			1				1						1						
February	1							1	1	1											
March		1	1					1		1			1								
April	1	1		1	1						1										
May	4									1			1								
June	2	2	1	1	1	1															
July			3	1		1						1									
August		2											1		1						25
September			2		1	1															
October					1			2					1								
November		1		1	1	1			1	1							1				39
December		1	2										1		1						
Total number	8	9	10	4	6	4		4	2	5	1	1	5		3		1				2

1846.

January		1						1	1												
February			2												2	1					
March	1																				
April		1	1										1		1						
May			2		1	1	1	1													
June			1	3																	
July		1	1							1											
August	1				1	2	1		1												
September										1					1						
October			1					1		1											
November		1		1	1	1	1	1		1	1										
December						2	1		1												
Total number	2	4	8	5	4	3	5	4	2	3	1	1	1	1	4	1					

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1847.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January		1					1						1								
February										1								1			
March	1		1																		
April		1																			
May			3									1									
June	1		1	1	2	1			1		2					1					
July	1			1		1						1									
August							1														
September	1					1			1										1		49
October								1				1									24, 25
November						1				1											41
December		2					1	1					1	1	1						
Total number	4	4	5	2	2	4	3	2	2	2	2	3	2	1	1	1	1	1	1	1	4

1848.

January					1	1							1								25
February		1					1														30
March		1	1		1										1						
April					2																
May								1	1				1								21
June				1		1															29
July	1	1	2		1	1															
August		1	1																		32
September			2															1			
October	1	1			1																33
November	1			1	1				1									1			
December	1		1	1	3			1	1												
Total number	4	5	7	3	10	3	1	2	2	1			2		1			1	1		6

1849.

January	1	1			1																
February		1		1																	
March		1				1															21, 31
April	1	1	1								1										
May	1	1	2	1			1								1						
June	2		1	1	1																
July		1	2									1									
August		4	1				1											1			
September			1			1		1	1	1											
October					2				1		1										28
November								1								1					
December	1		1		1			2			1										
Total number	6	10	9	3	6	2	2	5	1	1	2	2			1	1		1			3

1850.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January.....			1		2					1		1									21
February.....				1			1						1								
March.....			1		2					1				1		1					
April.....	1				2												1		1		
May.....	1	2			1		1				1										22
June.....	2			1						2											
July.....	1	1		1				1		1											
August.....	1		2		1													1			23, 25
September.....			1					1												2	
October.....		1						1				1									
November.....									1			1		1				1			
December.....			1		1		1						1	1				1			
Total number.....	6	4	6	2	9		3	3	1	5	1	3	2	2	1	1	2	1	1	2	4

1851.

January.....			1			1				1											
February.....										1				1	1						
March.....										2											23
April.....								1		1	2					1					
May.....		1	1								1								1		
June.....				1					2												
July.....			1	1		3			2	1											
August.....	1	1		1	1	1		1					1								
September.....	1		2	1		1		1				1	1								
October.....		1						1				1									
November.....		1	1				1										1				23
December.....					1				1				1								
Total number.....	2	4	6	4	2	6	1	5	4	6	4	1	2	1	1	1	1		1		2

1852.

January.....	1					1		1				1									
February.....			3					1						1		1					
March.....			1						1	1					1						
April.....	1											1		1			1				24
May.....																				1	
June.....		2	1		1																
July.....		1					1	1													
August.....		1	1		1			1	1			1		1							29
September.....		1																			
October.....	1	1								1			1								
November.....				1		1	1														25
December.....			1						1				2								
Total number.....	3	6	8		3	2	2	4	3	2		3	3	3	1		1		1		3

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1853.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January			1						1						1	1					23
February		1		1		1				1					1						
March		1		1				1													
April		1	1	1	2				2							1					
May								1		1	2	1									
June	1	1				1															30
July				1		1		2	1		1								1		
August			1	1	1							1		1			1				
September			1				1	1		1			1								
October			1	1										1							
November	1	1	1											1							21
December						1			1					1							25
Total number	2	5	6	6	3	5	1	4	5	3	3	2	1	4	2	1	1		1		5

1854.

January			4					1													
February			1		1	1									1					1	
March				1						1					1						25
April				1		1	1			1				1							
May		1		2									1	1							
June		1		1														1			
July								1						1				1	1		
August	3																				35
September					2		1				1										
October	1			1	1				1												
November	1				1	1				1	1										
December												1									
Total number	5	2	5	6	5	3	2	1	3	2	1	2	2	2			1	1		1	4

1855.

January		1				1	1			1											40
February													1								28
March	1	1	1		1																
April				1	1		1				1										
May				1	1	1					1										
June		2	1			1	1														
July	1	4	2			1	1									1					
August		1				1						1									22
September			1																		
October		2	1					1		1			1						1		
November			1			1		1													
December		1					1		1		1				1				1		
Total number	2	12	7	1	3	5	4	3	1	2	2	2	2		1	1		2			3

1856.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January			1							1					1						25
February	1		1		1				1												
March		1			1																
April	1		1	1			1							1							24
May	2							2													
June			1	2		1				1											
July	1		1	1			1						1			1					26
August	1				2			1					1								23
September	1		1		1					1			1		1						
October			1	1	1																
November	1			1	2	1															
December					1			1				1	1								23
Total number	8	1	7	6	7	3	2	4	1	3	1	1	2	1	2	1					5

1857.

January	2	1										1	1								25
February		1	1				1					1	1								
March		1			1		2					1							1		26
April					1	1						1	1								
May			1	1	1		2	1													
June		1	1	1	1			1				1									
July	1	1	3			1	1	1				1	1	1							
August	2	2		1				1			1	1	1								
September		1	1			1						1									
October			1			1	1												1		
November	1			1		1	2														
December			1	2				1			1	1		1							
Total number	6	7	8	6	5	4	7	5		4	2	5	1	2					1	1	2

1858.

January	1		1									1					1				
February	1		1									1	1								
March					1		1		1												
April		1	1	1				1		1	1										
May		2								2											
June	2	1	2														1				30
July		2	1	1	1										1						21
August		2	1		2											1					25, 27
September		1	1					1											1		
October		1	1									1	1	1							
November								1				1	1	1							
December	1		1	1	1					1											
Total number	5	10	10	3	5		1	3	1	4	1	2	5	2	1		2		1		4

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1859.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January	1				1	1									1						31
February	2	2	1	1			1														
March	1	1			1					1	1	1		1							25
April			1		2						1	1									
May											1										24
June	4	1	1			3															46
July	1	2		2																	
August	1	1		1	1			2				1									
September	1										1										24
October	1				1														1		
November	1		1			2	1														
December			1		1			2			1										
Total number	12	7	5	4	7	6	2	4	1	4	3		1	1					1		5

1860.

January	2	1	1	1																	
February	2			1	1	1		1	1												
March	2		1				1	1													
April	2	1	1	1	1																
May		1	1	1			1														
June	4					1							1						1		
July	3	1	1		2	1				1											
August	3	1			1	1		1	1												26
September							1	1	1		1					1					
October	3	1		1	1																
November	1	1		2				1	1				1								
December				1		1		1							2						
Total number	22	6	5	8	6	5	4	4	4	1	2		3		2	1		1			1

1861.

January			3	1				1			1				1						
February	2	1	1	1				1			1	1									
March	1	1				1					1	1									
April	2	2				1							1		1						21, 31
May	3	2			1				1				1								
June	3	3																			35
July	2	2	3				1														
August	1		1						1	1											24
September		1		2	1										1						
October			1	2	2		1														
November	1	2					1	1								1					
December		1											1								
Total number	15	15	9	7	4	2	3	2	3	1	1	3	3	1	2	1					4

1862.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January		1			2		1						1								30
February	3	1	1	1				1					1								
March			1		1										1				1		
April					1						1										
May		1			1					1	1										
June	4				1				1												51
July	3		1	1							1				1						
August	2		1		2																
September	1									1			1								23, 28
October	1			1	1							1									27
November	1	2		2	1									1							21, 31
December	1						1								1						
Total number	16	5	4	6	9		2	1	1	2	3	1	3	1	2				1		7

1863.

January	1	1	1		1		1			1								1			
February		2			1				1									1			
March	1		3				2	2				1									
April				1			1						1								32
May		1		1	1								1								
June	1	1	1	1						1											
July	3	1	3			1						1									21, 21, 21
August	2				1				1						2						
September	2	1	1						1	1											
October	1			1	1				1		1										
November	2							1							1						25, 26
December									1	1		1									26
Total number	13	5	11	4	4	2	4	3	3	4	1	4	2		3			2			7

1864.

January			2												1						25
February							1		1												
March			1				1	1				1								1	
April		1					1										1				
May	3						1	2	1												
June	1	1							1												
July			1	1					1												
August	3	1	1																		33
September	3	1					1		1												
October	1	1		1					1				1								
November									1	1								1			
December			1	1								2					1				
Total number	8	7	7	3		4	4	4	4			1	3			1	2	1		1	2

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1865.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January				1	1		2							1		1					
February															1						40
March					1							1						1			21
April	1				1		1		2												
May	1				1				1											1	28
June		1												1							
July	2			1	1		1				1	1									
August		2	1																		
September	1	1																			
October		1	2		1											1	1				
November					1											1			1		
December	1	1	1	1	1		1		1	1											
Total number	6	6	5	3	7		5		4	1	1	2		2	1	3	1	1	1	1	3

1866.

January				1	1					1											
February		1				1	1									1					26
March			1				1	1									1				
April	2	1		1	1		1														
May		2			1	1	1						1				1				
June		3	1					2			2										
July	1	2	2	1		1															
August	1	1	1	2		1	1														
September	1	1			1	1				3		1									
October	3	1							1						1						
November			1	2	1																24
December			2		1			1		1	1										
Total number	8	11	9	7	5	5	6	4	2	5	3	1	1		1	1	2				2

1867.

January				1	1			1				1									30
February		4	1				1				1										42
March	1			1	1	1			1		1							1			
April	2	2	1	2	1																
May	1		2	1						1									1		
June						2	1														
July	1	2	1		1				1		1										
August		1							1	1	1										21, 33
September	1		2																		
October		2														1					22
November	2	2			1		1		1												
December	2	4		1	1						1										
Total number	10	17	8	6	7	2	2	3	3	2	4	1				1		1	1		5

1868.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 2 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January.....			1		2			1		1		1									32 23, 43
February.....		2				1	1								2						
March.....				1		2															
April.....	1	4				2					1	1									
May.....	1					1				1	1	1									
June.....			2					1						1			1				26 23
July.....	1	1				1							1								
August.....		1				1						1									
September.....	1	1	2		1	1		1				1									
October.....		2						1			1										
November.....		1						1		1	1		1								5
December.....	2	1		1			1														
Total number.....	6	13	5	2	3	9	2	3	2	2	5	3	3	1	2		1				5

1869.

January.....			1				1	1						1	1						24
February.....									1		1										
March.....		1			1	1			2					1						1	
April.....				1			1			1											
May.....			1	1	1	3								1	1						26 23
June.....				1	2			2	1					1							
July.....	1		3																		
August.....	1				1	1	1														
September.....	1			1		1								1							21
October.....		1						1		1						1					
November.....		1		2		1			1	1											4
December.....	1									1					1						
Total number.....	4	3	5	6	5	7	2	4	5	3	1			4	3	2			1		4

1870.

January.....			1	2										1					1		23
February.....						1	1		1	1								1	1		
March.....	2																				
April.....		3				1			1												
May.....						1			1												32, 25
June.....					1	1															
July.....		2		1												1					
August.....			1											1							
September.....	1		3															1			26
October.....				1				2					1								
November.....				1	1														1		
December.....	1					2		1		1											
Total number.....	4	5	5	5	2	6	3	3	2	2	1	1	1	2	1	1	1	2	1	1	5

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1871.

	DEPTHS IN TENTHS OF AN INCH.																				Depth of Rains greater than 9 inches.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
January	2								1				1								24
February			1				1	1		1	1										
March	1	1	1			1	1	1													30
April					1		1			1						1					
May		2			1												1				
June					1	2			1			1							1		
July	1		1			1		1										1			47
August				1		1				2			1		1						
September	1								1												
October									1		1										
November			1			1						1	1								
December		1	1		2									1							
Total number	5	4	5	1	7	6	3	2	4	4	2	2	3	1	1	1		1	1		3

1872.

January		1			1													1			
February					1				1												
March			1	1	2		1	1		2		1									
April		1	1	2							1										
May	2	1			1	1				1			1								
June	1			1	2	1					1										
July	2	1	2		1	1					1		1							1	
August	1	1	1			1			1					1							28
September								1	1				1		1				1		
October	1	1		1								1		1							21
November		2		3											1						
December	2	1		3									1								35
Total number	9	9	5	11	5	6	1	1	2	4	2	4	2	3				1	1	1	3

1873.

January					2	1		1							1			1			
February			1					1									2				
March	1				2		1	1	1												
April		2			1	1														1	
May			2														1	1			
June		1	1																		23
July		2			1	1	1	1													
August		2	1	1						1									1		39
September	1	2	1												1						
October									1						1						24
November	1						1						1	1				1			
December			1	1															1		24
Total number	3	9	8	2	7	3	3	4	1	1	1		1	1	3		1	5	2	1	4

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1853.....	2	5	6	6	5	1	4	5	3	2	1	4	2	1	1	1	1	1	1	2	1	1	108	2	
1854.....	5	2	5	6	5	3	2	2	1	3	2	2	2	1	1	1	1	1	1	1	1	60	8		
1855.....	2	1	2	7	1	3	5	3	1	2	2	2	1	1	2	1	1	1	1	1	1	1	120	2	
1856.....	8	1	7	6	7	3	2	4	1	3	1	1	2	1	1	1	1	1	1	2	1	108	1		
1857.....	6	7	8	6	5	4	7	5	4	2	5	1	2	1	1	1	1	1	1	1	1	123	3		
1858.....	5	10	10	3	5	1	3	1	4	1	2	5	2	1	1	1	1	1	1	1	1	110	4		
1859.....	12	7	5	4	7	6	2	4	1	4	3	1	1	1	1	1	1	1	1	2	1	115	2		
1860.....	22	6	5	8	6	5	4	4	1	2	3	2	1	1	1	1	1	1	1	1	1	46	0		
1861.....	15	15	9	7	4	2	3	1	1	3	1	2	1	1	1	1	1	1	1	1	1	134	0		
1862.....	16	5	4	6	9	2	1	1	2	3	1	3	1	2	1	1	1	1	1	1	1	51	0		
1863.....	13	5	11	4	2	4	3	3	4	1	2	3	2	1	3	1	1	1	1	2	1	117	0		
1864.....	8	7	3	4	4	4	4	1	3	1	3	1	2	1	1	1	1	1	1	1	1	114	0		
1865.....	6	6	5	3	7	5	4	1	1	2	2	3	1	1	1	1	1	1	1	1	1	119	0		
1866.....	8	11	9	7	5	6	4	2	5	3	1	1	1	2	1	1	1	1	1	1	1	122	0		
1867.....	10	17	8	6	7	2	2	3	2	4	1	1	1	1	1	1	1	1	1	1	1	42	0		
1868.....	6	13	5	2	3	9	2	3	2	5	3	1	2	1	1	1	1	1	1	1	1	43	0		
1869.....	4	3	5	6	5	7	2	4	5	3	1	4	3	2	1	1	1	1	1	1	1	115	1		
1870.....	4	5	5	5	2	6	3	3	2	2	1	1	1	1	1	1	1	1	1	2	1	88	6		
1871.....	5	4	5	1	7	6	3	2	4	2	3	1	1	1	1	1	1	1	1	1	1	47	9		
1872.....	9	9	5	11	5	6	1	1	2	4	2	3	1	1	1	1	1	1	1	1	1	105	0		
1873.....	3	9	8	2	7	3	3	4	1	1	1	1	1	1	1	1	1	1	1	1	1	99	29		
Totals.....	313	247	301	191	154	114	89	120	161	73	48	32	22	31	19	23	18	10	12	14	20	11	4,291	155	
																						9	2	10	

The average number of rainy days per year in forty-two years—155 days out of 15,340, or about a hundredth part, having been omitted—is 102.16.

The following table gives every storm of which the time of beginning and ending was recorded, and the rate of rainfall per hour during that time:—

Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
Dec. 6, 1834...	5	1.50	0.30	July 7, 1841...	1	0.20	0.20
" 29, 30, " ...	13	1	0.077	" 14, " ...	2	2.00	1.00
Feb. 6, 1835...	9	0.10	0.011	Sept. 4, " ...	2	0.30	0.15
Mar. 9, " ...	2	1.50	0.75	Nov. 12, " ...	6	0.60	0.10
" 10, " ...	9	0.75	0.08	" 29, " ...	16	1.00	0.063
" 22, " ...	16.5	1.15	0.07	Dec. 14, " ...	6	0.70	0.12
" 30, " ...	15.5	0.55	0.035	Apr. 7, 1842...	3.5	0.24	0.07
Apr. 13, " ...	3.5	0.03	0.01	May 11, " ...	3	0.68	0.23
" 16, " ...	11	0.45	0.04	Aug. 12, " ...	3	0.52	0.17
" 22, " ...	5	0.28	0.06	" 14, " ...	1	0.20	0.20
" 25, 26, " ...	26	0.85	0.03	" 18, " ...	1	0.25	0.25
" 28, " ...	6.5	0.85	0.13	" 29, " ...	1	0.25	0.25
May 14, 15, " ...	21.5	0.25	0.01	Sept. 25, 1843...	2	1.80	0.90
June 5, " ...	2	0.45	0.23	Mar. 4, 1844...	10	0.75	0.08
" 10, " ...	3	0.20	0.07	Apr. 9, 10, " ...	3.5	0.50	0.14
July 25, " ...	1	0.18	0.18	" 24, " ...	2.5	0.07	0.03
" 31, " ...	1	0.15	0.15	May 21, " ...	1	0.30	0.30
Aug. 3, " ...	1	0.10	0.10	" 27, " ...	1	0.10	0.10
" 21, " ...	1	0.15	0.15	June 9, " ...	1	0.15	0.15
" 28, " ...	12	0.35	0.03	" 22, " ...	4	0.80	0.20
Sept. 20, " ...	5.5	0.25	0.05	July 11, " ...	2	0.56	0.28
Jan. 18, 1836...	3	0.75	0.25	" 16, " ...	8	1.70	0.22
" 24, 25, " ...	13.5	2.50	0.17	Sept. 1, " ...	5.5	0.90	0.16
Feb. 7, 8, " ...	18	1.75	0.097	Nov. 11, " ...	1	0.27	0.27
June 17, " ...	0.25	0.90	0.90	May 25, 1845...	1	0.05	0.05
Sept. 29, " ...	15.5	0.35	0.02	June 21, " ...	4	0.30	0.08
Nov. 2, 3, " ...	20	1.65	0.08	" 24, " ...	1	0.35	0.35
" 12, " ...	4.5	1.05	0.23	Oct. 9, " ...	1	0.50	0.50
" 15, " ...	3	0.15	0.05	Nov. 27, " ...	9.5	3.85	0.41
" 21, " ...	7.5	0.95	0.13	Feb. 20, 1846...	11.5	0.33	0.03
May 5, 1837...	3	0.42	0.14	May 18, " ...	1	0.50	0.50
" 6, " ...	2	0.14	0.07	" 23, " ...	3	1.43	0.48
July 24, " ...	2.5	0.45	0.18	June 15, " ...	1	0.35	0.35
Aug. 3, " ...	2	0.85	0.43	July 11, " ...	1	0.28	0.28
Dec. 10, " ...	3.5	0.75	0.22	Aug. 8, " ...	2	0.35	0.18
June 14, 1838...	1	0.25	0.25	" 10, " ...	2	0.45	0.23
" 17, " ...	1	0.20	0.20	" 14, " ...	1	0.10	0.10
" 22, " ...	1	0.65	0.65	Sept. 8, " ...	2	1.37	0.685
" 25, " ...	1	0.60	0.60	" 12, " ...	2	0.96	0.48
July 5, " ...	1	0.05	0.05	Feb. 3, 1847...	11.5	0.96	0.08
Aug. 6, " ...	1	0.90	0.90	June 29, " ...	4	0.90	0.23
" 25, " ...	6.5	2.05	0.32	July 13, " ...	1	0.08	0.08
Oct. 24, " ...	16	0.95	0.06	Nov. 14, " ...	18.5	1.00	0.05
Dec. 8, " ...	3	0.30	0.10	" 19, " ...	7	0.62	0.09
" 22, " ...	4.5	0.15	0.03	Ap. 13, 14, 1848...	6	0.45	0.075
May 29, 1839...	1	0.25	0.25	July 5, " ...	1	0.60	0.60
July 7, " ...	1	0.15	0.15	Mar. 15, 1849...	4	0.55	0.14
" 11, " ...	1	0.62	0.62	Apr. 20, " ...	1	0.10	0.10
" 18, 1840...	2	0.81	0.41	June 4, " ...	1.5	0.37	0.24
" 24, " ...	2	1.55	0.77	Aug. 12, " ...	5.25	0.56	0.106
Ap. 12, 13, 1841...	20	1.75	0.087	Dec. 19, " ...	3	0.27	0.09
May 23, " ...	1	0.33	0.33	" 20, " ...	1	0.10	0.10
July 1, " ...	1.5	0.33	0.22	Jan. 18, 1850...	8	1.00	0.125
July 5, " ...	1	1.75	1.75	" 25, " ...	5	0.30	0.06

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Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
Feb. 14, 1850...	6	1.28	0.21	Sept. 15, 1854...	2	0.45	0.23
Mar. 23, "...	13.5	1.00	0.08	Oct. 3, "...	5	0.40	0.08
Apr. 12, "...	5	0.10	0.02	May 24, 1855...	2	0.60	0.30
" 13, "...	4	0.45	0.11	June 30, "...	2	0.70	0.35
June 25, "...	1	0.10	0.10	July 5, "...	1	0.25	0.25
July 19, "...	8.5	1.00	0.12	" 18, "...	1	0.15	0.15
" 28, 29, "...	2.5	0.75	0.30	" 31, "...	1	0.10	0.10
Aug. 4, "...	3	0.30	0.10	Aug. 4, "...	1.5	0.62	0.42
" 6, "...	2.5	2.25	0.90	Sept. 27, "...	3	0.25	0.08
" 7, "...	1	0.25	0.25	Dec. 9, "...	13	1.75	0.13
" 13, 14, "...	11.5	1.80	0.15	Mar. 6, 1856...	4	0.20	0.05
" 25, "...	11	2.50	0.23	June 4, "...	1	0.25	0.25
Sept. 3, "...	5	2.00	0.40	" 9, "...	2	0.55	0.28
" 7, 8, "...	28.5	2.00	0.08	" 27, "...	1	0.37	0.37
Sept. 27, "...	1	0.75	0.75	July 6, "...	1	0.65	0.65
May 20, 1851...	1	0.15	0.15	" 22, "...	2	0.30	0.15
July 25, "...	1	0.60	0.60	Aug. 8, "...	2	1.25	0.63
" 26, "...	1	0.37	0.37	" 17, "...	1	0.50	0.50
Aug. 9, "...	2	1.25	0.63	Sept. 11, "...	1	0.30	0.30
Sept. 2, "...	1	0.60	0.60	" 13, "...	1	0.10	0.10
" 21, "...	1	0.10	0.10	May 31, 1857...	2	0.35	0.18
Nov. 2, "...	4	0.25	0.06	July 21, "...	1	0.10	0.10
Dec. 15, "...	4.5	0.50	0.11	Sept. 6, "...	1	0.20	0.20
Mar. 24-5, 1852...	9	0.85	0.09	June 6, 1858...	1	0.25	0.25
June 20, "...	1	0.20	0.20	" 21, "...	1	0.30	0.30
" 22, "...	1	0.25	0.25	July 11, "...	3	1.35	0.45
July 2, "...	1	0.20	0.20	" 22, "...	1	0.35	0.35
" 26, "...	11	0.78	0.07	Aug. 1, "...	3	0.25	0.08
Aug. 7, "...	1	0.87	0.87	" 17, "...	2	0.20	0.10
" 10, "...	2	0.50	0.25	" 18, "...	1	0.45	0.45
" 15, "...	1	0.25	0.25	Sept. 4, "...	2	0.80	0.40
Nov. 12, "...	6	0.60	0.10	Mar. 12, 1859...	6	1.10	0.18
Feb. 3, 1853...	2	0.60	0.30	June 10, "...	4	0.25	0.06
" 7, "...	3	0.15	0.05	" 29, "...	1	0.62	0.62
July 9, "...	2	0.60	0.30	July 22, "...	1	0.12	0.12
" 16, "...	4	0.40	0.10	" 25, "...	2	0.35	0.175
Nov. 24, "...	1	0.10	0.10	Sept. 13, "...	1	0.10	0.10
May 5, 1854...	2	0.20	0.10	Oct. 14, "...	1	0.12	0.12
June 28, "...	1	0.20	0.20				

In twenty-six years previous to 1860, the time of rainfall is recorded in 185 storms:—

In 131 storms, rain fell at the rate of 0.25 inch per hour, or less.

" 18	"	"	"	"	0.33	"	"	about.
" 9	"	"	"	"	0.40	"	"	"
" 7	"	"	"	"	0.50	"	"	"
" 8	"	"	"	"	0.62	"	"	"
" 3	"	"	"	"	0.67	"	"	"
" 3	"	"	"	"	0.75	"	"	"
" 4	"	"	"	"	0.87	"	"	"
" 1	"	"	"	"	1.00	"	"	"
" 1	"	"	"	"	1.75	"	"	"

The two storms giving 1 inch and 1½ inch per hour fell on the 5th and on the 14th of July, 1841.

In one case, where the time of rainfall was less than an hour, the rate is made as though the rain was an hour in falling.

Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
April 6, 1860...	1	0.30	0.30	Dec. 24, 1865...	12	1.01	0.08
" 17, " ...	3	0.10	0.03	Jan. 26, 1866...	1.5	1.03	0.68
June 7, " ...	3	0.12	0.04	April 22, " ...	1	0.21	0.21
Aug. 22, " ...	7	2.55	0.36	July 18, " ...	1	0.09	0.09
Sept. 20, " ...	6	0.85	0.14	" 27, " ...	3.5	0.39	0.11
Nov. 12, " ...	1	0.15	0.15	Sept. 4, " ...	2	0.99	0.49
" 23, 24, " ...	12	0.85	0.07	" 8, " ...	3	0.95	0.32
Dec. 22, " ...	14	1.47	0.11	Dec. 4, " ...	2	0.33	0.16
" 30, 31, " ...	17	0.37	0.02	Jan. 17, 1867...	15	3.00	0.20
Jan. 18, 1861...	4	0.40	0.10	Apr. 1, " ...	6	0.41	0.07
" 24, " ...	6	1.10	0.18	" 5, " ...	9	0.26	0.03
" 26, 27, " ...	16	0.30	0.02	" 22, " ...	1	0.24	0.24
Mar. 9, " ...	8	1.10	0.14	" 27, " ...	3	0.11	0.04
" 21, 22, " ...	25	1.45	0.06	July 4, " ...	1.5	0.48	0.32
" 27, " ...	11	0.57	0.05	Aug. 2, " ...	3	1.20	0.40
Apr. 1-3, " ...	41	2.12	0.05	" 2, " ...	4	2.10	0.62
" 30, " ...	2	0.10	0.05	Oct. 15, " ...	1	0.18	0.18
May 4, " ...	3	0.15	0.05	Nov. 16, " ...	3	0.15	0.05
" 25, " ...	1.5	0.05	0.03	Dec. 10, " ...	5	0.20	0.04
" 27, " ...	14	0.45	0.03	" 20, " ...	6	0.12	0.02
" 29, " ...	11	0.12	0.01	" 26, " ...	5	0.35	0.07
June 23, " ...	1	0.03	0.03	Jan. 23, 1868...	8	0.54	0.07
" 29, " ...	1	0.07	0.07	Apr. 7, " ...	13	3.20	0.25
July 17, " ...	1	0.12	0.12	June 16, " ...	1	1.12	1.12
Aug. 5, " ...	1	0.85	0.85	June 9, " ...	1	0.25	0.25
Nov. 3, " ...	17.5	1.45	0.08	June 17, " ...	2	1.44	0.72
May 19, 1862...	3	0.20	0.07	July 5, " ...	1	0.58	0.58
June 4, " ...	1	0.50	0.50	Aug. 20, " ...	3	0.56	0.18
" 5, " ...	18	4.60	0.25	Sept. 13, " ...	1	0.25	0.25
" 27, " ...	1	0.10	0.10	" 16, " ...	1	0.10	0.10
" 30, " ...	1	0.45	0.45	Nov. 26, " ...	5	0.83	0.17
July 2, 3, " ...	15	1.10	0.07	Dec. 7, " ...	12	0.67	0.06
" 9, " ...	4	0.10	0.02	Mar. 15, 1869...	9	0.60	0.07
Aug. 9, " ...	1.5	0.05	0.03	" 23, " ...	8	0.85	0.11
Sept. 28, " ...	1	2.00	2.00	Apr. 29, " ...	15	0.65	0.04
Nov. 17, " ...	7	0.40	0.06	May 2, " ...	1	1.40	1.40
Jan. 10, 1863...	6	0.65	0.11	" 26, " ...	1	0.50	0.50
Feb. 3, " ...	7	0.03	0.004	July 11, " ...	1.5	0.32	0.23
" 22, 23, " ...	20	1.00	0.05	" 14, " ...	1	0.26	0.26
May 12, " ...	0.50	0.21	0.21	" 16, " ...	2	0.05	0.03
July 25, " ...	4	0.29	0.07	Sept. 7, " ...	3.5	0.60	0.14
" 26, " ...	3	2.08	0.70	Jan. 8, 1870...	8	0.35	0.04
Aug. 16, " ...	1	1.52	1.52	Mar. 18, " ...	3	0.12	0.04
Oct. 17, " ...	2	1.07	0.53	May 10, " ...	1	1.20	1.20
Jan. 1, 1864...	16	1.61	0.10	June 14, " ...	1	0.60	0.60
July 25, " ...	5	0.75	0.15	" 17, " ...	1	3.15	3.15
Aug. 14, " ...	1	0.09	0.09	" 20, " ...	2.5	2.52	1.00
" 3-5, " ...	34	3.35	0.10	July 17, " ...	1	0.23	0.23
" 7, 1865...	1	0.30	0.30	Aug. 25, " ...	1	0.31	0.31
" 11, " ...	5	0.22	0.04	Sept. 25, " ...	2	0.11	0.05
Sept. 6, " ...	4	0.22	0.05	Oct. 12, " ...	8	0.44	0.03
Oct. 10, " ...	1	0.32	0.32	Oct. 31, " ...	5	1.25	0.25

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Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
Feb. 14, 1871...	10	0.95	0.09	June 8, 1872...	1	0.47	0.47
Mar. 10, " ...	4	0.53	0.13	" 14, " ...	0.50	0.50	0.50
" 21, " ...	14	2.40	0.17	July 5, " ...	1	0.22	0.22
April 2, " ...	13	1.00	0.07	" 16, " ...	2	1.16	0.58
" 21, " ...	1	0.50	0.50	" 17, " ...	3	0.25	0.08
May 22, " ...	1	0.15	0.15	Aug. 13, " ...	3	0.25	0.08
July 28, " ...	2	0.81	0.40	Sept. 19, " ...	5	0.88	0.18
" 30, " ...	1	1.83	1.83	Dec. 26, " ...	15	1.25	0.08
" 31, " ...	1	0.10	0.10	Mar. 10, 1873...	9	0.25	0.03
Aug. 8, " ...	3	1.50	0.50	April 6, " ...	3	0.24	0.08
" 16, " ...	1	0.62	0.62	" 19, " ...	2	0.18	0.09
" 30, " ...	5	0.36	0.07	June 28, " ...	1	2.32	2.32
Sept. 17, " ...	1	0.83	0.83	July 1, " ...	2	0.70	0.35
Oct. 11, 12, " ...	27.5	4.68	0.17	" 11, " ...	1	0.55	0.55
" 28, " ...	1	0.03	0.03	" 27, " ...	5	0.81	0.16
Feb. 3, 1872...	13	1.00	0.08	Aug. 3, " ...	1	0.17	0.17
April 13, " ...	3.5	0.30	0.09	" 22, " ...	5	3.90	0.78
" 22, " ...	5	0.35	0.07	Sept. 19, " ...	11	1.54	0.14
May 19, " ...	6	0.96	0.16				

In fourteen years, to the 1st of January, 1874, the time of rainfall is recorded in 139 storms:—

In 98 storms, rain fell at the rate of 0.25 inch per hour, or less.							
" 9	"	"	"	"	"	0.33	" " about.
" 2	"	"	"	"	"	0.40	" " "
" 10	"	"	"	"	"	0.50	" " "
" 5	"	"	"	"	"	0.60	" " "
" 3	"	"	"	"	"	0.70	" " "
" 2	"	"	"	"	"	0.80	" " "
" 1	"	"	"	"	"	0.90	" " "
" 1	"	"	"	"	"	1.00	" " "
" 1	"	"	"	"	"	1.12	" " "
" 1	"	"	"	"	"	1.20	" " "
" 1	"	"	"	"	"	1.40	" " "
" 1	"	"	"	"	"	1.52	" " "
" 1	"	"	"	"	"	1.83	" " "
" 1	"	"	"	"	"	2.00	" " "
" 1	"	"	"	"	"	2.32	" " "
" 1	"	"	"	"	"	3.15	" " "

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Of those storms giving an inch or more per hour, —

One fell in 1862.	Three fell in 1870.
" " 1863.	One " 1871.
" " 1868.	" " 1873.
" " 1869.	

Making nine such storms in fourteen years, against two in the previous period of twenty-six years. Seven of these storms occurred in the last six years.

Where the time of rainfall was less than an hour, it is reckoned as having been an hour in falling.

Dr. Caswell made special memoranda of storms which were so extraordinary as to demand it. I give below the principal facts in regard to these:—

1862, June 4 and 5.—Extraordinary rain. A heavy thunder-shower occurred between the hours of 1 and 2 on the morning of the 4th. About 9 o'clock a steady rain set in, which continued, with slight intermissions, and at times pouring heavily, till about 4, A.M., of the 5th. For eighteen hours it was a pretty steady pour of rain. The rain-gauge held, as the result of the thunder-shower, a little less than

half an inch, and for the entire rain five and one-tenth inches of water (5.10). "My impression is, that there has been but one case in this city, in a period of thirty years, in which an equal quantity of water fell in so short a time. It is worthy of note, that the barometer stood at about 30.00 inches, and fell only about a tenth of an inch during the storm." [The rate of fall per hour was a little more than a quarter of an inch in depth.]

1862, Sept. 28. — "Very heavy rain from 2 to 3, P.M., with some thunder. Nearly two inches of rain fell in the course of one hour."

1863, Aug. 16. — "Very heavy thunder-shower between 5 and 6, P.M., 1.42 inches of rain falling in about 20 minutes."

1864, Aug. 3 and 5. — "Rain. The total amount of rain which fell from midnight, Tuesday, to 10, A.M., Thursday, was 3.35 inches. In the same storm, the quantity which fell from 10, A.M., of the 3d, to 10.20, A.M., Aug. 4, at Peacedale, South Kingston, was reported to be 6.70 inches." [The rate per hour in Providence was about $\frac{1}{10}$ of an inch; in Peacedale, about $\frac{3}{10}$ of an inch.]

1867, Jan. 17. — 7, A.M., to 7, P.M. "Snow, reported to be 20 to 24 inches on a level. Equal to 3.00 inches of rain."

1868, April 7. — "Began to snow at 7, A.M.; snowed till 1, P.M., when it turned to rain, and rained until 8, P.M. Total amount which fell, 3.20 inches."

1870, June 17. — "Thunder-shower between 12, M., and 5, P.M. Amount 3.15, nearly all of which fell between 12, M., and 1, P.M.; being the largest quantity I have ever known in so short a time."

1871, Oct. 11 and 12. — "Rain. Total quantity, from 7, A.M., of the 11th, to 10.30, A.M., of the 12th, 4.68 inches." [Rate per hour, $\frac{1}{8}$ of an inch.]

The following table, showing the amount of rainfall, and the rate per hour, is made up from the records kept by our employés at Hope Reservoir in this city : —

Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
Mar. 26, 1873...	5.3	0.02	0.004	July 27, 1873...	1	0.30	0.30
" " "...	2	0.23	0.11	" " "...	0.1	0.10	0.10
Apr. 12, "...	2.75	0.18	0.06	" " "...	0.8	0.23	0.23
" 12, 13, "...	19½	1.62	0.09	Aug. 3, "...	1.2	0.20	0.17
" 13, "...	12½	0.05	0.004	" 13, 14, "...	2.3	1.61	0.69
" 17, 18, "...	12	0.54	0.04	" 18, "...	3.5	0.25	0.07
" 19, "...	0.66	0.04	0.04	" 18, 19, "...	13.25	1.20	0.09
" " "...	1½	0.04	0.03	" 22, "...	4.3	0.85	0.19
" 29, "...	1.2	0.05	0.04	" " "...	3	2.77	0.92
May 2, "...	9.5	0.65	0.07	" " "...	2.6	0.40	0.15
" 2, 3, "...	11½	0.27	0.02	Sept. 1, "...	0.1	0.05	0.05
" 3, "...	4½	0.34	0.07	" " "...	0.75	0.01	0.01
" 3, 4, "...	10	0.29	0.03	" 4, "...	1	0.01	0.01
" 9, 10, "...	18.5	1.60	0.09	" " "...	0.25	0.07	0.07
" 10, "...	11.5	0.13	0.01	" " "...	0.6	0.01	0.01
" 12, "...	0.5	0.03	0.03	" 19, "...	4.25	0.90	0.21
" 21, 22, "...	6	0.23	0.04	Oct. 20, "...	0.6	0.01	0.01
" 24, "...	15	0.25	0.02	" " "...	0.6	0.05	0.05
June 7, "...	1	0.07	0.07	" " "...	2.2	0.05	0.02
" 11, "...	1.5	0.17	0.12	" " "...	1.2	0.05	0.04
" 28, "...	0.5	0.02	0.02	" 27, "...	7.25	0.60	0.08
" " "...	3.0	2.38	0.79	" " "...	3.6	0.45	0.12
July 1, "...	0.5	0.13	0.13	Nov. 7, 8, "...	3.25	1.60	0.49
" " "...	2	0.68	0.33	" 17, 18, "...	14	0.95	0.07
" 11, "...	0.2	0.02	0.02	" 18, "...	2.2	0.05	0.02
" " "...	0.3	0.01	0.01	" 25, "...	2.3	0.01	0.004
" " "...	0.7	0.59	0.59	Dec. , "...	7.0	0.10	0.01
" " "...	0.2	0.04	0.04	" 9, "...	3.8	0.15	0.04
" 17, "...	2.3	0.02	0.01	" 11, "...	4.2	0.075	0.02
" " "...	1	0.20	0.20	" " "...	2.6	0.05	0.02
" " "...	2	0.03	0.015	" 26, "...	13.5	0.75	0.05
" " "...	0.7	0.15	0.15	" 27, 28 "...	16.25	0.45	0.03
" 27, "...	0.75	0.30	0.30				

Where the time of rainfall was less than an hour, it is reckoned as having been an hour in falling.

The following table of rainfall, and rate per hour, is made up from the records kept by our employé at Sockanosset Reservoir in Cranston :—

Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
Apr. 2, 1873...	7.1	0.43	0.06	Aug. 20, 1873...	0.5	0.08	0.08
" 6, " ...	2.9	0.28	0.09	" 22, " ...	17	1.25	0.07
" 9, " ...	5	0.10	0.02	" 23, " ...	1	0.25	0.25
" 12, 13, " ...	2.3	1.50	0.65	" 23, " ...	0.2	0.08	0.08
" 17, 18, " ...	9.2	0.76	0.08	" 30, " ...	3.1	0.42	0.14
" 19, " ...	3.9	0.06	0.01	" 31, " ...	2.5	0.50	0.20
May 2, " ...	14.8	0.89	0.06	Sept. 1, " ...	0.25	0.12	0.12
" 3, " ...	9.2	0.66	0.07	" 4, " ...	5.5	0.20	0.03
" 9, " ...	8	2.62	0.33	" 14, " ...	4.5	0.12	0.03
" 11, " ...	13.8	0.49	0.03	" 19, " ...	8.7	1.62	0.19
" 13, " ...	0.6	0.06	0.06	" 23, 24, " ...	10.5	0.32	0.03
" 17, " ...	5.2	0.01	0.002	" 29, 30, " ...	5	0.20	0.04
" 21, 22, " ...	6.7	0.25	0.04	Oct. 5, " ...	1.3	0.20	0.15
" 24, " ...	0.25	0.28	0.28	" 7, " ...	6.5	1.30	0.20
June 7, " ...	12.9	0.60	0.05	" 7, " ...	12.5	0.70	0.05
" 11, " ...	0.1	0.20	0.20	" 19, " ...	3.75	0.30	0.09
" 28, " ...	2.0	1.00	0.50	" 20, " ...	17	1.10	0.06
July 1, " ...	2.1	0.17	0.08	" 27, " ...	18.5	0.75	0.06
" 1, " ...	4.8	0.11	0.02	Nov. 7, 8, " ...	14.25	1.55	0.11
" 11, " ...	0.75	0.64	0.64	" 12, " ...	5.75	0.74	0.13
" 17, 18, " ...	13.25	0.33	0.02	" 16, " ...	5	0.24	0.05
" 19, " ...	3.75	0.21	0.06	" 17, 18, " ...	27	1.05	0.04
" 27, " ...	3.1	1.60	0.52	" 24, " ...	12.25	2.20	0.17
" 28, " ...	1.1	0.25	0.23	Dec. 5, " ...	2.75	0.30	0.11
" 30, " ...	0.6	0.02	0.02	" 9, " ...	6.9	0.22	0.03
Aug. 1, " ...	1.1	0.25	0.23	" 12, " ...	3.75	0.70	0.19
" 3, " ...	0.75	0.20	0.20	" 13, " ...	8	1.90	0.24
" 14, " ...	23	2.45	0.11	" 23, " ...	5	0.10	0.02
" 18, " ...	13.25	0.25	0.02	" 26-28, " ...	47.5	1.45	0.03
" 19, " ...	17.1	1.40	0.08				

Where the time of rainfall was less than an hour, it is reckoned as having been an hour in falling.

The following table of rainfall, and rate per hour, is made up from the records kept by our employes at Pettaconset Pumping-Station in Cranston:—

Date.	Hours.	Am't.	Rate.	Date.	Hours.	Am't.	Rate.
Apr. 9, 10, 1873...	10.5	0.10	0.009	Aug. 22, 1873...	8.	1.28	0.16
" 12, " ...	7	1.37	0.20	" 30, " ...	3.2	1.68	0.53
" 12, 13, " ...	31	0.26	0.009	" 31, " ...	1.75	0.28	0.16
" 18, 19, " ...	13	0.76	0.06	Sept. 1, " ...	0.3	0.05	0.05
May 2, " ...	2	0.98	0.49	" 4, " ...	5.3	0.20	0.03
" 3, " ...	9	0.82	0.09	" 14, " ...	8.25	0.23	0.03
" 9, 10, " ...	26	2.42	0.09	" 19, " ...	8.5	1.60	0.19
" 11, " ...	17	0.45	0.02	" 23, 24, " ...	11.25	0.30	0.025
" 13, " ...	12.5	0.08	0.006	" 29, 30, " ...	4.5	0.20	0.04
" 21, 22, " ...	6.5	0.25	0.04	Oct. 5, " ...	4	0.20	0.05
" 24, " ...	0.5	0.30	0.30	" 7, " ...	22.25	2.25	0.10
June 7, " ...	1	0.46	0.46	" 8, " ...	2	0.08	0.04
" 11, " ...	0.25	0.18	0.18	" 19, " ...	4.5	0.36	0.08
" 28, " ...	1.8	1.00	0.67	" 20, " ...	21.5	0.94	0.04
July 1, " ...	2.9	0.25	0.08	" 27, " ...	12	1.10	0.09
" 11, " ...	0.75	0.52	0.52	Nov. 7, 8, " ...	13.5	1.65	0.12
" 17, 18, " ...	18.75	0.32	0.02	" 12, " ...	26.75	0.70	0.03
" 19, " ...	4.25	0.35	0.08	" 15, " ...	4	0.15	0.04
" 27, " ...	15.25	1.42	0.09	" 17, 18, " ...	16.25	1.10	0.06
" 28, " ...	0.75	0.15	0.15	" 24, " ...	12.25	2.10	0.17
Aug. 1, " ...	1.1	0.38	0.35	Dec. 4, " ...	4.5	0.55	0.12
" 3, " ...	0.6	0.20	0.20	" 9, " ...	19.25	0.25	0.01
" 14, " ...	10.5	2.55	0.24	" 12, " ...	18	0.70	0.04
" 18, " ...	1.25	0.18	0.14	" 13, " ...	19.75	1.90	0.09
" 19, " ...	1.75	0.72	0.41	" 23, " ...	5	0.10	0.02
" 19, " ...	0.3	0.18	0.18	" 26, 28, " ...	47.30	1.55	0.03

Where the time of rainfall was less than an hour, it is reckoned as having been an hour in falling.

Mr. Bazalgette, chief engineer to the Metropolitan Board of Works of London, says, "Careful observations of the quantity of rain falling on the metropolis within short periods have been made [by him] for many years. Taking an average of several years, it has been ascertained that there are about one hundred and fifty-five days per annum upon which rain falls: of these, there are only about twenty-five upon which the quantity amounts to a fourth of an inch in depth in twenty-four hours.

"But there are, in almost every year, exceptional cases of heavy and violent rain-storms; and these have measured one inch, and sometimes even two inches, in an hour."

Mr. R. Rawlinson says, "In Birmingham, on the evening of Sunday, the 6th of July, 1845, there fell 1.945 inch of rain in little more than half an hour. This is, no doubt, such a flood as is seldom met with; but equal volumes of rain have fallen in the metropolis and in other places in England."

Mr. Hawksley says, "In the great storm in London, in August, 1846, $3\frac{3}{8}$ inches fell in two hours and twenty minutes; and at Nottingham he had known 1.16 inch to fall in less than half an hour."

The Annual Report of Mr. John Roe, surveyor to the Holborn and Finsbury sewers, Jan. 29, 1847, contains the following, which, I suppose, refers to the storm mentioned by Mr. Hawksley: "In August last, the surveyor had occasion to report that 4 inches in depth of rain had fallen in one hour on the first of that month, — a circumstance that cannot be too extensively known at a time when much sewer work is likely to be executed in this country; for, having once experienced such a fall of rain, it is right to expect and provide for the like occurrence in future."

Mr. J. Newton says, "On the 29th of July, 1857, he registered at Preston $\frac{3}{4}$ of an inch of rain in thirty-five minutes; and on the 8th of October, 1861, nearly the same depth in thirty minutes."

The Croton Aqueduct Board speak of a storm in 1866 as

follows: "The use of the pipe sewers has proved entirely successful; and, thus far, no complaints have reached the department of any stoppage or inefficiency in their working. No severer test of their capacity could be required than the effects of the extraordinary rainfall of Oct. 30-31 last, in which, in a period of about five hours, upward of 4 inches of rain fell."

It is probable that there is never any rainfall which entirely reaches the sewers. Especially in the summer season, when the most rapid rainfalls occur, there is much loss by absorption and evaporation.

In a report of Mr. Bidder, Mr. Hawksley, and Mr. Bazalgette, distinguished English engineers, made in 1858, on the subject of the metropolitan drainage, it is stated that observations had been made which had enabled them to arrive at some reliable conclusions, and that

"The result of these observations distinctly establishes the fact, that the quantity of rain which flowed off by the sewers was, in all cases, much less than the quantity which fell on the ground; and although the variations of atmospheric phenomena are far too great to allow any philosophical proportions to be established between the rainfall and the sewer-flow, yet we feel warranted in concluding, as a rule of averages, that $\frac{1}{4}$ of an inch of rainfall will not contribute more than $\frac{1}{8}$ of an inch to the sewers, nor a fall of $\frac{1}{10}$ of an inch more than $\frac{1}{4}$ of an inch. Indeed, we have recently observed rainfalls of very sensible amounts failing to contribute any distinguishable quantity to the sewers."

Mr. W. Haywood said, in a discussion before the Institution of Civil Engineers in London in 1865, —

"The observations of Mr. Bidder and Mr. Hawksley in 1857, upon the Savoy-street sewer, showed, that, of a rainfall of 2.90 inches in twenty-six hours, only $64\frac{1}{2}$ per cent of the fall was delivered into the sewers, all the rest being either absorbed or evaporated. In the Ratcliff highway sewer they found, on the same occasion (which was an unusual rainfall, it having rained without ceasing, he be-

lieved, for twenty-six hours), that 52 per cent of the total quantity only was discharged into the sewers. It so happened, that, without any co-operation with the gentlemen named, he was, at the same time, engaged in gauging the flow of the London-Bridge sewer, which drained an area of 2,250 acres, partly urban, and partly suburban: it was necessary that this should be known, as the character of the surface much affected the quantity delivered into sewers in times of storm. Now, with the same rainfall, or rather a fall of 2.75 inches instead of 2.90 inches, being the amount recorded by Mr. Glaisher on the occasion alluded to, he found, that, in the London-Bridge sewer, 53 per cent of the total quantity only ran off.

“On one occasion, in April, 1858, he had gaugings taken of the same sewer, when 0.24 of an inch of rain fell in an hour and a half. He then found that 74 per cent of the total quantity was run off, leaving 26 per cent absorbed or evaporated. Of a rainstorm of 0.54 of an inch in five hours, in June, 1858, there was delivered into the Irongate sewer, which drained an area entirely paved and built over, as much as 94½ per cent of the total rainfall; and that, of all the storm-gaugings he had made, was the greatest percentage of rainfall he ever knew to be discharged by a sewer. In August, 1858, with a rainfall of 0.48 inch in one hour and two-thirds of an hour, he found only 78 per cent of the total quantity discharged into the Irongate sewer. There were, of course, many circumstances which would affect the quantity of water which would be discharged into sewers from rainfalls: no two cases would be alike. Storm-gaugings had been, he believed, but little taken by any one: in fact, it was a difficult matter to get them taken at any time, as they required men to be in readiness at any moment to make the observations, and competent assistants to see that the men did their duty. He had paid much attention to these points for many years: he had had the requisite staff in readiness; and he believed his observations were as accurate as it was possible to make them.”

Mr. Baldwin Latham, C.E., of London, says, "In the case of Croydon, where the geological formation principally consists of gravel overlying chalk, the amount of rain contributed by a storm of 0.72 of an inch in twelve hours, in October, 1865, did not yield more than one-tenth of it to the sewers."

The experience of Mr. Hawksley has been very great; and his formula for the dimensions of sewers is used by English engineers of the highest standing. He stated to the Institution of Civil Engineers, in 1852, that "the most serious inconvenience had not always been found to arise from a sudden and heavy fall of rain of short duration, but more frequently from a prolonged fall of less hourly amount."

Not only are smaller sewers sufficient to carry a given rainfall by reason of the loss by absorption, evaporation, and other causes, but also on account of the length of time required for the water to reach the sewers. That which falls near the outlet runs through the sewer, and escapes, before that falling at a distance has reached it.

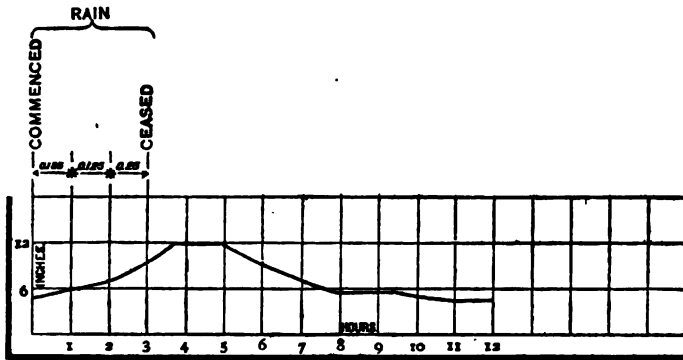
Mr. John Roe had an experience of twenty years as surveyor to the Holborn and Finsbury districts, during which time he took repeated observations of the effect of storms in filling the sewers, requiring for their record more than a hundred memorandum-books. Rain-gauges were kept to ascertain the depth of rainfall. The observations seem to have been made at frequent intervals, and through day and night when necessary.

To illustrate the length of time required for the water of a rainfall to reach the sewers, Mr. Roe gave two illustrations, which were published in the Report of the General Board of Health, London, in 1852. From those illustrations the cuts given on the following page were copied.

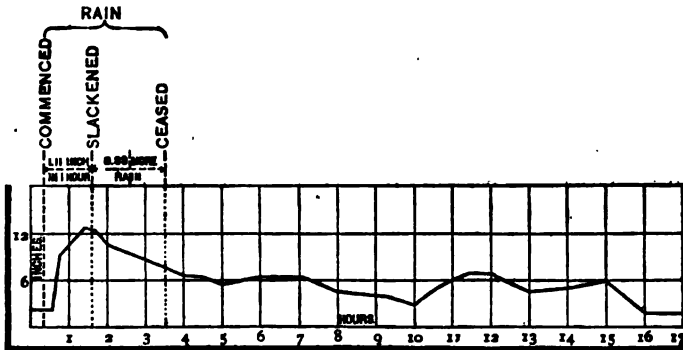
Unfortunately, Mr. Roe does not give the rate of inclination nor the character of the surface from which the water flowed, nor other facts which it would be useful to know; but I infer that the diagrams are given as fair samples of what may be expected in a district like his, where the

extreme difference of elevation is about 400 feet in a distance of five miles.

In the first case, half an inch of rain fell in three hours ; and, at the end of twelve hours, the effect of the storm had ceased in the sewer.



No. 1.



No. 2.

In the second case, 1.11 inch of rain fell in one hour, followed by 0.53 inch in the next two hours ; and the effect ceased in about sixteen hours.

We estimate from the diagram, in the first case, that, if the total effect had been expended at the maximum rate of flow, all the storm-waters would have been discharged in four and a half hours ; and from the middle of the storm to the mid-

dle of such maximum flow would have been about three and nine-tenths hours. The maximum rate of flow actually continued about two hours after the storm had ceased.

In the second case, we estimate, that, at the maximum rate of flow, the storm-waters would have been discharged in six hours. At a uniform rate of rainfall, taking the first hour as a basis, the storm would have lasted about an hour and eighteen minutes. In this case, the maximum rate of flow occurred at about the time the storm slackened; but from the middle of the storm to the middle of our estimated maximum flow would have been about five and seven-tenths hours.

In a letter dated Dec. 3, 1852, written in defence of his tables of sizes of sewers for carrying off one inch of rain per hour, based on his observations, and under circumstances which would induce him to give the heaviest drainage with which he was acquainted (his sizes having been thought too large), Mr. Roe said, "I have observed 25 cube feet of water per minute per acre reach the sewers from an inch fall of rain in the hour, from a surface where the houses have much garden-ground attached; and in another case, where the houses were nearer together, 33 cube feet per acre per minute. That greater falls of water do take place, and that not unfrequently, is a well-known fact. I have known ten instances of the kind during the period of my observations in the Holborn and Finsbury sewers" [twenty years].

The total quantity of water from an inch of rain in an hour would amount to $60\frac{1}{2}$ cubic feet per minute per acre.

The sizes of sewers in Providence have been based on the supposition that $30\frac{1}{2}$ cubic feet per minute per acre would need to be carried away in the sewers without entirely filling their section. The formula by which the sizes are determined gives rather larger sewers for given conditions than would result from Mr. Kirkwood's formula proposed for Brooklyn, and larger than would result from Mr. Hawksley's formula—so generally used by English engineers—on

low grades and large sizes, but smaller for great falls and small sizes, and larger in all cases than the tables of sizes given by Mr. Roe.

On the other hand, the sizes are smaller than would be required by the formula of Neville, except for the smallest sewers.

I have used this formula as a guide in determining the sizes of sewers for many years; and the practical results have encouraged me to feel very safe in continuing to do so.

No formula can be used arbitrarily for all cases: the local circumstances must vary the results, according to the judgment of the engineer.

Recently I have made a modification for the purpose of giving expression to the allowance for slope of the surface on which the rain falls, which has heretofore been made a matter of judgment in each case.

The first sewer constructed in Providence, under this department, was in North Main Street. The grade of the sewer for about nine-tenths its length — 2,558 feet — is 0.28 per 100. The general slope of the surface from North Main Street to Prospect Street rises at about twelve to fifteen feet per hundred. The mean of grades on ten streets between North Main Street and Benefit Street is 13.35 per 100; on seven streets between Benefit Street and Congdon Street is 14.47 per 100; on eight streets between Congdon Street and Prospect Street is 7.53 per 100. Bowen Street, between Congdon and Benefit, falls 24.40 per 100 to Wheaton Street, and 17.86 per 100 to Benefit Street.

This is a much steeper urban territory than I had previously had experience with; and I have since thought that possibly too little allowance was made for the slope in determining the size of the main sewer. But no case of flooding in the public sewer has come to my knowledge, though we have had several very heavy rains since its construction in 1871.

At the present time, a considerable territory, which it is proposed to finally turn through the College-street outlet, discharges its waters through this sewer.

I observed the effect of a very heavy rain, on the afternoon of the 22d of last August, upon the flow of the North Main Street sewer. An unusually large proportion of the rainfall probably reached the sewer, as the ground was thoroughly soaked, and the surfaces of buildings and streets had been well wet, and small cavities filled, by rains on the 20th and 21st, and by a rain of 0.85 inch depth, ending at about two o'clock on the 22d.

In "The Providence Daily Journal" of Aug. 20 appeared the following:—

RAIN.—On Thursday the 14th we had one inch and nine-tenths (1.90); yesterday and last night we had one inch and twelve-hundredths (1.12); making, in less than a week, a rainfall of a little over three inches (3.02). The ground in this vicinity is thoroughly wet. If we have a severe drought, it must be late in the season. A. C.

Aug. 19.

Dr. Caswell's records show a fall of 3.90 inches on the 22d in five hours.

Our records, carefully kept at Hope Reservoir, — within the North Main Street district, — show a fall of 4.06 inches from the 14th to the 21st inclusive, of which 0.30 fell on the 21st. The total rain on the 22d was 4.02 inches, of which 0.85 inch fell before two o'clock. At about three o'clock, P.M., the rain began again; and in three hours 2.77 inches of rain fell. During a part of this time, the rain was considerably heavier than the average. While and after the fall was heaviest, I spent nearly an hour examining the sewer. At the outlet, under Great Bridge, the sewer was running about or slightly more than half full; between Market Square and Meeting Street the sewer was from one-half to two-thirds full, though, in one or two places, occasional waves carried the water a little higher; at Smith Street, where the men had been removing gravel and stones which had been washed in, during a storm, through a lateral sewer at that time being laid, and where a portion of the cleansing apparatus still hung in the manhole and dipped into the flow of the sewer, the run of water was

so high, that the wavy motion just carried the surface of the water to the crown of the sewer. It thus appears that the rain which many inhabitants thought was among the heaviest they ever knew, was well taken care of; but, as the sewerage of the upper portion of the district approaches completion, it may become desirable to construct through Smith Street into Moshassuck River such an overflow for excessive storm-waters as has been contemplated for some of the other sewers. Especially is this true if the frequency of heavy storms, so notably increased in the last few years, is to continue.

Perhaps I have given an unnecessary amount of space to the question of rainfall: but it is one of great importance to my mind, involving, on the one hand, expense from damage to property if the sewers are too small; and, on the other, expense of construction, and loss of scouring effect in the ordinary flow, if the sewers are needlessly large.

DEPTH OF SEWERS.

The depth at which the new sewers have been laid has excited considerable discussion, of which the tendency has been against such a depth as is believed, on the whole, to be for the best interest of the community.

It is not thought best, as a rule, to place the bottom of the outlets, at the established harbor-line, lower than about one foot above mean low tide. The Dorrance-street sewer, which is circular, five feet and a half in diameter, and running through the lowest section of the city, is planned so that the bottom of the invert, when extended to the harbor-line, will be at mean low tide. Even at that level, and with the least inclination considered allowable (one foot in a thousand), the material of the crown of the sewer will form the surface of the street at the junction of Washington and Cove Streets. As the rise and fall of the tide is five feet, the inside crown of the sewer will be half a foot above mean high tide at the outlet.

This limit of height on account of the tide compels a less depth for the sewers, in many cases, than would otherwise be desirable.

Mr. Kirkwood, in his description of the Sewerage Works of Brooklyn, says, "The rise and fall of the tides average five feet. The bottom of the outlet of the sewer is generally placed about a foot above low-water mark."

Mr. Chesbrough, in his Report on a Sewerage System for New Haven, says, "The bottom of the main sewers at the outlets is to be about one foot above low tide, the East-street outlet having been constructed a little higher. Experience shows that sewers which are not unnecessarily large, and have proper inclination, very rarely have deposits in them where the tide ebbs and flows through them." "It may be proper to state, that the outlet sewers so located would be empty twice in twenty-four hours, and that the scouring effect of this discharge would have the tendency to prevent the deposit of sediment in the sewers."

The experience we have had where the sewers have been completely constructed indicates that the action of the tide is a positive advantage,—the sewers keeping quite clean, except about where the level of high tide intersects the bottom of the sewer; and it seems probable that the flow of sewage, when the houses are generally connected, will tend to prevent settlement at that point.

Our general rule has been, where practicable, to place the inside crown eight and a half feet below the level of the curbstone. The irregularities of the surface, and the necessary inclination of the sewer, cause this depth to be sometimes less, and sometimes greater, than the standard. In the steep hillside streets, especially where rock is encountered, the grade has usually been raised to seven feet below the curb.

On Plate 13 a section is given to show the greatest allowable depth of a private drain, according to the rules established by the Board of Aldermen, when the main sewer is eight and a half feet below the curbstone. On a street forty

feet wide, the top of the private drain, at the line of property, cannot be more than eight feet and an inch below the curb; and, at a distance of a hundred feet from the street, the depth cannot be more than six feet. On a wider street these depths must be less. If, however, the grade of the street is steep, and the junction is carried well below the property to be drained, the depth of the private drain in the property can be increased.

On business-streets, a greater depth than the above would, in many cases, be very valuable.

One of the greatest advantages of a good system of sewerage is the withdrawal of subsoil waters below the foundations of buildings. This has been proved, very generally, to increase the health of communities, especially in lessening the amount of consumption and other lung-troubles. Of course, the greater the depth of main sewer, the more marked is the effect produced.

Krepp, an English writer on "The Sewage Question," says the average depth of sewers is seldom much less than fifteen feet.

Baldwin Latham, author of "Sanitary Engineering," recently published in London, speaks of twenty-foot cuttings for sewers as ordinary.

A comparison of the cost of the large sewers built in the Holborn and Finsbury divisions with those in the Westminster division, made in Dempsey's "Treatise," gives the "average depth of excavation twenty feet." In giving the cost of sewers of medium size executed in the neighborhood of London, they are said to be "in an average excavation of fifteen feet." It is further shown that the regulations of the former commissioners of sewers for the city of London (perhaps still in force) required that the bottom of a common sewer should not in any part be less than twelve feet beneath the surface of the street.

"A sewer . . . passes under Canonbury (Islington) at a depth of sixty-eight feet from the surface."

Mr. Haywood, engineer to the city of London, has said,

"The sewers I have built are rarely less than from twelve to fifteen feet below the surface to the water-bed."

The least general depth for the main sewers in Leicester is twelve feet below the surface.

By the Health Report of 1854, it appears, that, in Rugby, "the average depth of the public sewers is ten feet six inches, and two main lines are, in parts, one twenty-one, and the other twenty-eight feet deep." It had been claimed that these sewers are too shallow for a densely-populated district.

Corfield (1871), after speaking of the evils of the too shallow depth of sewers, says, "The new sewers in most of the towns have been placed at such depths as 'from sixteen feet in the mid town to four or five feet in many other parts of the town (Stratford-on-Avon).' At Rugby they are 'at an average of eleven feet deep from the surface, varying from seven to twenty-five feet.' At Worthing they begin superficially, and are twenty feet deep at the outfall. The London sewers vary much in depth."

He says, further, that the sewers of Penzance—from which surface-waters are excluded, and with no subsoil drains—"lie at an average depth of nine feet."

In the Minutes of Proceedings of the Institution of Civil Engineers, it appears that in Manchester, Eng., "the main or street drains are laid at various depths, from 9 feet to 30 feet." Also that in Dundee "the average depth of the sewers is 12 feet, which was considered necessary in order to secure proper drainage of the cellars. The surface-levels being very irregular in many places, the depths of the cuttings consequently varied; the smallest depth, which was in trap-rock, being 7 feet, and the greatest 21 feet. The deepest cutting in trap-rock (19 feet) occurred in the centre of the town, across the base of Castle Rock. The total amount of rock excavated was 24,000 cubic yards." Also in a report on the sewerage of Newport, that "the prices of the sewers up to and including 3 feet by 2 feet 2 inches are given for an average depth of 10 feet, for the pur-

pose of easy comparison, though many of them were laid deeper. The depths of the sewers 4 feet 6 inches in height are the average of excavations actually made, the greatest depth being about 20 feet." The depths given were $12\frac{1}{2}$, $13\frac{1}{2}$, and $15\frac{1}{2}$ feet. A statement in regard to the sewers of Paris in 1865 gives the depth for one class of sewers at about $10\frac{1}{2}$ feet, and for another class about 14 feet.

From a plan representing the drainage of the new portion of Hamburg, I find forty-eight points where a comparison of grades can be made, showing the depths to be from 11 to 19.5 feet. The Hamburg foot is about 0.94 of an English foot. The average depth of the forty-eight cases is about 13.3 English feet. At one point where a sewer was tunnelled, it is 40 feet below the surface.

Much of this territory was originally marsh-land, and subject to overflow.

Col. Adams's Report to the Commissioners of Drainage of the City of Brooklyn, in 1857, contains the following statement: "The grade of street-sewers generally to be 13 feet below the level of the curb. Custom, both here and in the city of New York, may be considered as having fixed this dimension." The present practice in Brooklyn is to lay the "brick sewer invert 13 feet, pipe sewer invert 12 feet, below grade of street."

In Boston, it is the practice to "lay suburban sewers at 9 feet, except when there is great disparity in the different sides of the street, and then somewhat deeper; or in ledge, perhaps, skim down to $7\frac{1}{2}$ or 8." For business, a depth of 12 feet is considered about right; "that is, give 10 feet clear to the highest water-line in the sewers."

In Jersey City, the chief engineer has "made it a rule, where possible, to arrange the water-run of sewers 12 feet below curb-grade."

In Newark, N.J., "the sewers generally are about 13 feet below the street-grades; that depth being considered sufficient for ordinary cellars. Some of the sewers are much deeper, and many on the low ground are of less depth; but, wherever practicable, the depth above named is aimed at."

In Philadelphia, the chief engineer makes "the house connection with sewers in the centre of a 60-foot street at $8\frac{1}{2}$ feet below curb-level, which gives sufficient fall from the average depth of cellars; and, if practicable, make the bottom of the connection at springing-line of sewer, which would make the bottom of a 3-foot sewer 10 feet below curb-level."

The city civil engineer of Cleveland writes, "We cannot adopt any uniform depth for sewers in this city, the surface of the ground is so rolling; but, for main sewers, our minimum depth is 20 feet, and for branch sewers 12 feet, unless it be in exceptional cases."

The acting chief sewerage engineer of Cincinnati writes, "We generally put our brick or main sewers to the depth of 15 feet, and our pipe or lateral sewers to the depth of 13 feet."

Mr. Chesbrough, in his Report to the City of New Haven, says, "Generally the bottom of the pipe sewers should be 10 feet below the grade of the street; and the bottom of the brick sewers should be about 2 feet lower, or 12 feet below the grade of the street."

I had a special wish to know the ruling depth in Chicago, on account of the great expense incurred to raise the grades in that city to secure proper drainage. I therefore wrote to Mr. Chesbrough, who replied as follows:—

OFFICE OF THE BOARD OF PUBLIC WORKS,
CITY HALL, CHICAGO, JAN. 7, 1874.

J. HERRERT SHEDD, Esq., *Chief Engineer Water-Works*,
PROVIDENCE, R.I.

DEAR SIR, — I have never been able to fix, in my own mind, upon a depth for the bottoms of the inverts of sewers below the surfaces of the streets above them to suit all or even the generality of cases. My opinion is, that it is best to take 12 feet where you can get it; and sometimes it is very important to have even more. In Chicago we rarely have as much as 12 feet, and often have to get along

with 9 feet, and even less, especially where the streets have not been brought up to grade yet, and may not be for years to come.

Yours very respectfully,

E. S. CHESBROUGH.

Subsequently Mr. Chesbrough wrote, —

“We endeavor here to look ahead, and make some difference, on account of expense, between the depths of sewers on streets likely to become important business-thoroughfares and those likely to be used only for private houses.”

The following is a copy of a letter received from St. Louis : —

CITY OF ST. LOUIS, ENGINEER'S DEPARTMENT,
ST. LOUIS, Dec. 23, 1873.

J. HERBERT SHEDD, *Chief Engineer Providence Water-Works.*

DEAR SIR, — Yours of the 18th instant is at hand, inquiring about the average depth of our sewers; and I would say that our main sewers vary from 10 to 60 feet in depth, as the topography of our city is such that it is necessary to pass through dividing ridges to reach basins which originally drained through cavities in the rock which underlies the place. Some of these basins cover areas of upwards of 1,000 acres, one of which has just been reached by a tunnel through the solid rock, 1,400 feet long, the deepest point being 60 feet below the surface of the street; another by a sewer made in open cut 47 feet deep; and there are several others similar to those mentioned.

The bottom of Mill-creek sewer, which is 20 feet wide and 15 feet high, is from 20 to 34 feet below the surface. This sewer has now reached a distance of $2\frac{3}{4}$ miles from the river.

But for the smaller sewers, where they follow a regular inclination, the average depth is about 16 feet. This is for public sewers which are constructed for main channels of drainage, to receive district sewers, which are carried in all

directions to drain the district, — these are made at an average depth of about 12 feet.

The sewers first made in the central part of the city, about twenty years ago, are from 10 to 12 feet deep from the surface to the bottom of the sewer, which answered for a while : but improvements with sub-cellars have, of late years, demanded deeper sewers ; and some have been made by private enterprise for special purposes. But I find that a depth of 16 feet for main sewers in the street, and 12 feet for district sewers, which are generally located on alleys, will give general satisfaction.

If you should desire any further information on this subject, I would cheerfully give any at my command.

Very respectfully,

WM. WISE,

General Superintendent of Sewers.

It will be noticed that sewers are very rarely laid as shallow as they have been in this city. I have thought from the first, as I have repeatedly expressed to you, that perhaps we ought, wherever practicable, except on the steeper hill-side streets, to lay the sewers deeper than we have been doing. But public opinion has seemed, heretofore, to be decidedly against this. As the value of land increases, the need of deeper cellars will be felt more than it is at present ; and the extent to which we ought now to provide for this need is worthy of serious consideration.

In comparing the depth of our sewers with the depth in other places, it must be borne in mind that we estimate the depth from the surface to the *crown of the sewer*. I have made this the rule, because it is of very little account where the bottom of a sewer is, when it is running full : we can have no drainage lower than its crown. Where sewers are made so large that storms never fill them, the crown-line is not a suitable guide ; though, in such cases, deposits often accumulate to such a depth that the flow is carried to the crown.

MATERIALS FOR SEWERS.

The quantities of materials purchased by this department for the construction of the new public sewers have been about as follows:—

Bricks,	{ plain	2,727,891
	{ narrow wedge	763,266
	{ wide wedge	159,200
Pipe Inlets,	{ 6 inch	2,296
	{ 12 inch	268
	{ 15 inch	24
	{ 12 inch	24,815 feet.
	{ 15 inch	2,850 "
	{ 18 inch	192 "
Scotch Drain Pipe,	{ 12"×6" branches	5,953 "
	{ 12"×12" "	903 "
	{ 12"×12" double branches	3 pieces.
	{ 12 inch quarter-turns	14 "
	{ 15"×6" branches	832 feet.
	{ 15"×12" "	126 "
	{ 18"×6" "	72 "
	{ 6 inch	1,517 "
American Vitrified Stoneware Pipe,	{ 12 inch	2,361 "
	{ 15 inch	1,191 "
	{ 6" (short socket)	160 pieces.
	{ 6" double branches	192 "
	{ 12"×6" branches	765 feet.
	{ 12"×12" "	61 "
Invert Blocks,	{ 15"×6" "	140 "
	{ large	4,873 "
Catch-Basin Coping and Gutter Stones,	{ small	1,887 "
	{ 513 sets, about one-third corner.	
Catch-Basin Covers		579= 45,061 pounds.
" " Traps		538= 35,600 "
Manhole Frames and Covers		650= 219,881 "
Iron Sewer Connections		25= 3,114 "
Iron Rods for Manhole Ladders		214 pieces.
Outlet Stones		5 sets.

The above account does not include the bricks used in sixteen sewers, for which proposals were received previous to October, 1872. The estimated number of bricks used on those sewers, which were furnished by the contractors, is 1,003,000. The contractors have also furnished the flagging-stones for the bottoms of catch-basins, the cement and sand

for mortar, lumber and concrete for foundations, material for jambs, surfacing material, and all tools and labor, of whatever description, necessary to the full completion of the works.

Other materials than those used by us have been employed in other places for the construction of sewers. Some of these are less expensive in first cost; and it may be thought, on this account, that they should be used here: but it has been proved by experience, that, in order to secure permanency and durability of sewer-work, great care is required in the selection of proper materials, and that the best materials procurable are the cheapest in the end.

The interior surface should be smooth and uniform, to facilitate the flow of sewage, and to offer no foothold for rats, or crevices for admitting roots of trees. Common building-stone will not answer this requirement, unless plastered on the inside; in which case the mortar is liable to be destroyed by chemical and by mechanical action.

The chemical action of the sewage, and probably, in some measure, of the gases found in sewers, is often destructive to most kinds of cement or lime-mortar; sometimes eating away that of the joints in brick sewers, so as to compel extensive repairs or rebuilding. For this reason, our specifications require the narrowest joints that are found to be practicable.

The cement pipes heretofore made in this country, so far as I have had experience with them (which accords with the experience of many engineers), have failed to answer the requirements of public sewers; largely, I think, on account of such chemical action, though there are other causes tending to their failure. It seems probable, from experiments made with Portland cement, that pipes or concrete made from that material, with sufficient care, may be safely used for sewers, except in unusually trying locations.

The grinding action of sand and other solid matter flowing with water over the invert of sewers wears them away more or less rapidly. To prevent such action as far as

possible, the hardest and toughest bricks should be used in that part of the sewer; and the pipes should be of a vitreous, imperishable material, tenacious, hard, homogeneous, and impervious in character, and uniformly glazed. Porous material is not suitable, nor pipes burned at a low temperature. Salt-glazing is more durable than the slip-glaze; and it has the advantage of requiring a more intense heat in the kiln, which insures a better pipe. Some kinds of clay which can be used to make sewer-pipes of a poor quality but fair appearance, if slip-glazed, are unable to stand the heat required for salt-glazing.

It will be noticed that three kinds of bricks are purchased. The plain bricks are of such shape as are ordinarily sold in the market, and are culled by us into several classes, according to quality, of which the best are used on the inside of the inverts, and the others in places of successively less importance; the poorest being built into the outer courses of manholes and catch-basins.

The wedge bricks are moulded through dies made after our designs, which give them shapes suitable for use in sewers of small diameter, and on inverts where the radius of curvature is small. The outer edge of the "narrow wedge" is half an inch wider than the inner edge; and of the "wide wedge" it is an inch wider. The inner and outer edges are curved to the proper radius. A small groove on each side of the "wide wedge" distinguishes it readily from the other. Bricks of this form allow less mortar to be used in the joints, and make more stable work in case the mortar is injured. The additional cost — about one dollar per thousand — is small when compared with the advantages gained.

The pipe-inlets are made to order, of stoneware, with one end cut on a bevel, so that, when the bevelled surface is placed true with the inside of a brick sewer, the axis of the pipe-inlet will make an angle of thirty degrees with the axis of the brick sewer. By this means the junctions of lateral sewers and drains are neatly made with the main sewers, so

that the current of the lateral shall join with that of the main with small disturbance to the flow. For an illustration, see Plate 5. The inlets are built in as the sewer progresses; and such as are not to be immediately used are plugged by plates of stoneware or by brick. The usual distance apart for inlets for house-drainage is twenty feet on each side of the sewer, or one inlet for each ten feet of sewer. At points where the main sewer is necessarily much deeper than is required for the drainage of cellars, vertical shafts of pipes are built up, and inlets are put in at the standard depth.

The prices of Scotch pipe and of American pipe suitable for our sewers have not heretofore been very different; and, as we have found the Scotch pipe to be of better and more uniform quality, we have used it almost exclusively. There are indications that the price of Scotch pipe will advance; and, on the other hand, the American manufacture has of late considerably improved. It is our wish, when it can be done without injury to the interests of the city, to use pipes of American make; and we watch with some care the progress of improvement.

The pipes are laid with full mortar joints, struck flush on the inside, and thoroughly cleaned out as the work progresses.

Invert blocks of two patterns, one for single-course and one for double-course sewers, have been made from our designs, for use in bad ground where an excess of water is very troublesome. A small section of each of these blocks may be seen on Plate 1; that for the single-course sewer on the 20" \times 30" section, and that for the double-course on the section immediately under. The length of the blocks is about two feet. The continuous opening through the blocks forms a convenient land drain for getting rid of the subsoil water, which very much facilitates the construction of the sewer in many places, and also serves to protect the cement in the invert from running water while it is setting.

All the cement used on the sewer-works has been fur-

nished by the contractors, under a requirement in the specifications that it shall be the best American hydraulic cement, proved to be good by such tests as the engineer prescribes. Previous to May, 1873, the tests were such as the inspector or engineer could readily make on the ground, with the occasional breaking of a sample to test its tensile strength. It was found, on examination, that most of the mortar on the completed work was very hard and good; but in a few places it could be readily dug out with a soft-pointed stick, and some work was rebuilt in consequence. The greatest trouble, under such inspection, arose from the irregularity in the quality of the cement. Specimens from barrels in a lot generally good would not set at all under water; and others, exposed an hour in air, and forty-eight hours under water, had a tensile strength of only ten to fifteen pounds to a square inch.

We had tried cements from nearly all the makers, under various conditions of exposure, usually breaking the specimens after seven days' immersion in water. It was finally determined to mix the cement clear with as little water as practicable, and form it in a mould, giving convenient shapes at the ends of the specimens for clasping in the testing-scales, and a section of one square inch in the middle. These specimens were numbered, and the time of mixing recorded. After an exposure of half an hour in the air, they were immersed in water, remaining twenty-four hours; after which they were broken in the testing-scales, and their strength recorded.

In May we began testing every barrel of cement used, and branding those which were accepted. At first it was difficult to get enough cement to use that would stand a strain of 30 pounds. But the quality of that offered for sale by the principal dealers soon improved materially; though it is still found that some will not set in water, and some will not bear sufficient handling to get it into the testing-scales. About the first of August, the standard was raised to 40 pounds; then, in a week, to 45 pounds; and in another week

to 50 pounds, where it has been held ever since. Samples are often left immersed for seven days before breaking; but, for American cements, we find our usual test to give reliable results.

Specimens from 9,964 barrels of cement have been tested since the first of May: of this number 1,048 were rejected. The average strength of specimens from accepted barrels used in June was about 39 pounds; that from accepted barrels used in July was about 52 pounds; that from accepted barrels used after July, and previous to February, was about 63 pounds.

The strength of cement received at one time may average much greater than that received at another. At times, it is not uncommon for the strength to reach 90, and even 100 pounds. Many samples have borne a strain of 110 pounds per square inch before breaking. The average strength of five hundred samples each, taken from three different makers after July 1, was, respectively, 63.26, 64.40, and 65.45.

Since the plan of regular testing was adopted, the engineer in charge and the inspectors have constantly examined the cement joints in the brick-work, and they have been found uniformly good. In some cases where it was necessary to take down brick-work, they were obliged to break the bricks to get them out.

APPURTENANCES.

Facility for examination, cleansing, and repairs, is essential to a good system of sewerage. Manholes leading from the surface of the street to the sewer furnish the most complete arrangement for this purpose. They are placed at every change in the direction of the sewer, whether in line or in grade; so that, with a light in one manhole, a person at the next may see at once whether any obstruction exists between. The curves which form the junctions of lateral with main sewers furnish the only exceptions to this rule. Between points of change in the line of sewer, manholes are

placed, about one hundred feet apart on the smaller sewers, and at varying distances greater than this on the larger ones. Illustrations of manholes are given on Plates 6 and 7. Where the sewers are small, and the depths moderate, we have generally furnished steps for ascending and descending by projecting bricks on the sides, as seen in Plate 7. For larger and deeper sewers, the straight iron rods, about an inch in diameter, built into the manhole, as shown on Plate 6, are considered safer. The manhole frame and cover are illustrated on Plate 12.

The cleansing of sewers, either by flushing or mechanical appliances, is made very convenient by means of these manholes.

The covers of the manholes are perforated with holes, about half an inch in diameter, to allow an escape of sewer-air for the purpose of ventilation. The great number of these openings, and their position in the middle of the street, giving opportunity for diffusion, in a large proportion of surface-air, make this, on the whole, the simplest and safest mode of ventilation at present known. It is probable that it may be necessary, before a very long time, to make special provision for a much larger escape of sewer-gases than can safely be passed through manhole covers, at the ends of the sewers having a high elevation, especially from the lateral sewers on Prospect Hill.

Illustrations of catch-basins, and coping and gutter stones, are given on Plates 8, 9, and 10. They are placed on the sides or at the corners of streets, and usually receive a run of water from about two hundred and seventy-five feet of gutter,—rarely less than one hundred and fifty feet, or more than four hundred feet, except where the works are incomplete. In Europe, the catch-basins, or gullies, are generally placed about one hundred and twenty feet apart; and they are much smaller than those ordinarily used in this country. Ours are as small as it seems safe to make them in the present condition of the streets. Experience has proved that they may be filled with sand and gravel in a single storm.

The opening through the coping-stone is quite sufficient to take all the water that should pass through the basin into the sewer. If the heaviest storm of which I have undoubted information—3 inches per hour—should fall on a street sixty feet wide, and no portion of it be evaporated or absorbed, and it should reach the opening without sensible velocity of approach, the opening would take all the flow from a length of six hundred feet of gutter, receiving the water from half the street. If the catch-basin ever fails to receive all the water it is intended to take, it will be because the gutter-paving is imperfect, and not because the opening is inadequate.

On the very steep streets, the velocity of water in the gutter, in a heavy rain, is so great, that it is difficult to arrange the paving to turn the flow into the basin. In such cases, some of the water passes by the opening; but it would be of no value to make the opening larger, though some more effectual arrangement for turning the water through it is desirable.

The chute, or connection between the catch-basin and sewer, is a twelve-inch circular pipe, and is as large as I have known to be used in any modern sewerage. A recent English author says the size of pipe for connecting street gullies with the public sewers, "in practice should not be less than six inches in diameter." The circular of the largest manufacturer of sewer material in England says the six-inch size is ordinarily used.

The floor of the catch-basin is formed of a single blue flagging-stone.

The trap is illustrated on Plate 11. It is made of cast iron, except the pin, which forms a hinge, that being of composition. After the plate is built into the brick-work, a bed of mortar is laid upon the side of the catch-basin, into which the trap is pressed, making a tight joint. The joint can be broken, and the trap lifted, at any time, if it becomes necessary to get convenient access to the chute.

Small round stones are filled around the catch-basins,

under the coping-stones, to a depth of four and a half feet, to prevent lifting of the coping-stones, or other injury, by frost.

The sewer-work has generally been done under contract, with the strictest inspection on behalf of the city. Notwithstanding the fact that the prices paid have been, as a rule, somewhat higher than are paid for the same sizes in some other cities, the contractors have, I think, in a majority of cases, done the work at a loss. This is probably owing, in large measure, to the very bad ground in which most of the sewers are built. The losses by the contractors have caused considerable increase in the rate of bids; and it has been thought best in several cases to do the work by the day. There are many advantages in this mode of doing the work; and it has proved, on the whole, more economical than to let the work at the higher bids. In the case of the Ives-street sewer, a saving of several thousand dollars was effected over the lowest bid received at the opening, though the ground proved rather worse than we anticipated.

PRIVATE DRAINS.

No amount of skill, care, and expense in building the public sewers will relieve the property-holder from the necessity of constructing his private drains with all possible care. These drains often cause, in the aggregate, more trouble, on account of imperfect plan and construction, than all the rest of a sewerage system.

The proper object of house-drains is to carry away from the premises all waste water, liquid refuse, and fecal matter; and, while arranged to perform this service effectually, they should also be so arranged that no sewer-gases can by any possibility be conveyed into houses. To do this, it is not enough to place water-traps at the various inlets of the house-drain, nor even to make the addition of a trap in the drain itself. The compression of the air in the drain, which may

often arise from many causes, will blow through any practicable traps at the inlets throughout the house; and the vacuum which has a tendency to form every time a large amount of water is thrown into the lower part of a house-drain makes a suction upon every trap that is above it. In this way the water is often drawn out of such traps; and, until they are again filled with water, a communication is opened for the passage of foul air into the rooms. Any imperfections at the joints of the drain will also allow such communication. There may be a dangerous amount of sewer-air in the house without its presence being suspected, as, in its worst forms, it is not necessarily of strong odor, nor in any way of a character to force itself on our attention. To prevent these evils, there should be systematic provision for constant ventilation in the drains, of such a character that the tendency would be rather for a draught from the house into the drains than from the drains into the house. The first requirement is to shut off, as far as possible, all communication for air from the public sewer to the house-drain; so that whatever the mismanagement of the sewers, either in construction or cleansing, the householder may be reasonably protected. For this purpose, our rules require all persons to place an effectual trap in the line of drain just before it leaves the premises. For an illustration of house drainage, see Plate 14. At the extreme left, the trap above referred to is represented: just back of it, connection is made with a down spout, which furnishes free communication for outer air to the drain, except when the spout is carrying rain-water. From the highest part of the soil-pipe within the premises a pipe of the full size is carried to a point above the roof of the building, making another open communication with the outer air. These two pipes, with the drain, form a siphon; and, under all ordinary circumstances, there will be a constant flow of air down the cooler leg, and up the warmer leg, keeping up a circulation of considerable value. Now, if the compression of air in the public sewer blows through the lower trap in the drain, the sewer-

air has a free escape to the outer air without causing an injurious pressure on the traps of the various inlets to the drain; and a sudden rush of water poured into the lower part of the drain is followed up by the outer air through one leg of the siphon, so that no vacuum can be formed sufficient to suck the water from the inlet traps. In the case of heavy rain, when the down spout is filled with water, no injury is done; but only a cessation occurs, for the time, of the flow of outer air through the siphon.

Private drains are often obstructed by carelessness, on the part of those using them, in admitting substances which they were not intended to receive. Sand, shavings, sticks, coal, bones, garbage, bottles, spoons, knives, forks, apples, potatoes, hay, shirts, towels, stockings, floor-cloths, broken crockery, &c., are among the substances that have been found in them.

Perhaps the most common and the most certain cause of obstruction to house-drains arises from grease, which, though fluid when it is hot, soon cools in the drains, and gradually, but certainly, closes them up. I have known drains from thirty to fifty feet in length closed nearly the whole distance from this cause. The amount which will collect from the waste of a single family is surprising to those who are not familiar with the subject. It ordinarily causes much more expense and inconvenience to allow this substance to run into the drain than to catch it in a grease-trap, from which it can be conveniently removed. An illustration of a trap for this purpose is given on Plate 15; and its proper position under a sink may be seen in Plate 14. The joint between the body and the cover may be well sealed by rolling up a rope of clay, about three-quarters of an inch in diameter, with a string through the middle, for convenience of handling, and laying it in the groove, when the cover will compress it so as to make a tight joint, that can be conveniently broken when necessary. I have sometimes had these grease-traps made with the top of the inlet-pipe level with the bottom of the outlet-pipe; in which case I suppose they will

bear longer neglect than when made as shown in this illustration. If such a thing is desired, the waste-pipe can be carried through the inlet, and dropped to the required level.

Vitrified and glazed stoneware pipes six inches in diameter are believed to be best for ordinary house-drains; lead or iron pipes four inches in diameter are suitable for soil-pipes; lead pipes two inches in diameter for sinks, if the distance to the grease-trap is short; and lead pipes one inch in diameter for bowls, bath-tubs, and other fixtures discharging comparatively clean water.

It is well to have one or more openings, covered with a cap, easily removable, at points in the drain, — as shown at the catch-basin on Plate 14, — so that a strong wire or flexible rod may be run into the drain to remove any obstruction that may occur. The use of a catch-basin in house-drainage is very rarely necessary, and should be avoided when practicable.

The established "Rules for laying Drains" are given in the Appendix. Persons are required to lay their private drains between the curbstone and the public sewer at the grade which will give the lowest allowable drainage to their estates, whether they wish to avail of such drainage immediately or not. The object of this is to prevent the tearing-up of the street-surface to relay the drains when such deep drainage becomes necessary.

The materials and workmanship for house-drainage should be of the best possible character. Care should be taken to provide against the ill effects of expansion and contraction, and against damage by settling of walls. The joints should be air and water tight: those in the stoneware pipes may be made of good cement-mortar; and, if a gasket is not used, great care should be taken to swab out the interior of the pipe, and leave all clean as the work progresses.

Although house-drains are laid at the expense of the owners of the premises to be drained, the "Rules" require the work to be done under the permission and supervision of the Water Commissioners, and under the immediate inspection

of their engineer of private drains ; also that it shall be done by a licensed drain-layer, under bond to do faithful work. These restrictions have been proved by experience, in many cities, to be necessary to secure housekeepers from the great annoyance to which they would otherwise be frequently subjected from imperfect arrangement or unfaithful execution.

The experience in Chicago is thus expressed in a report by Mr. Chesbrough: "As the usefulness of the sewers depends so much upon the faithfulness with which house-drains are laid, past experience shows that this work ought never to be put into the hands of unfaithful or irresponsible persons. In some cases, not only individuals have suffered much annoyance, as well as loss, but the sewers have had to be cleansed at an otherwise needless expense. Probably no system better than licensing competent and faithful persons can be devised : but great caution should be used in granting the licenses ; for the fact of unfaithfulness is not likely to be known, in many cases, till its consequences appear, which may not be for a year or two after the work is done, and the doer out of the city."

During construction, sand, gravel, and other materials, are likely to be washed into the sewers, and are sometimes carried long distances by the action of the water ; even, at times, into other sewers previously constructed. These obstructions, if on contract-work, are removed at the expense of the contractor, who is responsible for the good condition of his work six months after completion.

In some cases, sewers, which could at present have no outlet except through old drains laid at a higher grade, have been ordered by the city government ; and, where great necessity seemed to exist, they have been constructed. In these cases, wells or chimneys have been built at the lower end of the sewer, through which the flow must rise to find an outlet. Considerable attention is required to keep these sewers free from deposit ; but no great trouble has

occurred except on the Transit-street sewer, at Brook Street. Here the lift is about six feet; and the lower end became, on account of an open joint caused by a displaced pipe, entirely stopped by sand and other material. The sewer was opened, cleaned, and in some parts relaid, at the contractor's expense. These sewers will soon have suitable outlets by the construction of other sewers, which have already been ordered; when the need of special attention will cease.

The works cannot, in the nature of things, be entirely free from defects, either in the plans or the execution.

No engineer or inspector is recommended for appointment, unless, after careful inquiry, he is believed to be strictly honest, and to have sufficient skill; and every person who has not proved himself well suited to his position has been removed.

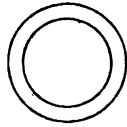
If, as the work goes on, the best men are retained, and the others relieved, it may fairly be expected that the imperfections will be reduced to a minimum.

The work is, on the whole, better than I have ever before seen executed for a similar purpose.

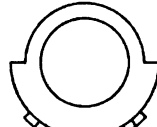
I think the city is very fortunate in having a corps of men in the subordinate offices who have so skilfully and faithfully performed their duties.

Respectfully submitted.

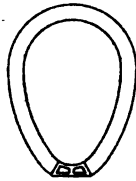
J. HERBERT SHEDD,
Chief Engineer.



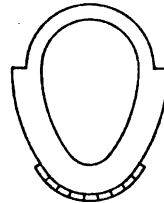
22"x22"



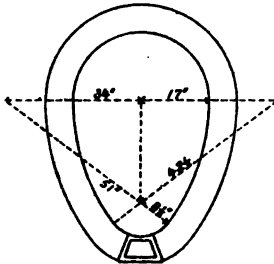
22"x22"



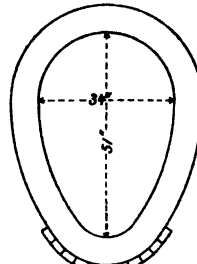
20"x30"



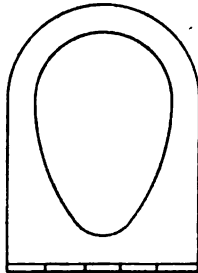
20"x30"



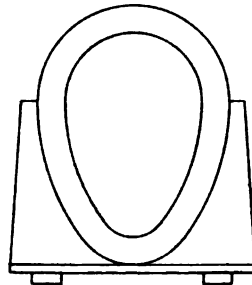
34"x51"



34"x51"

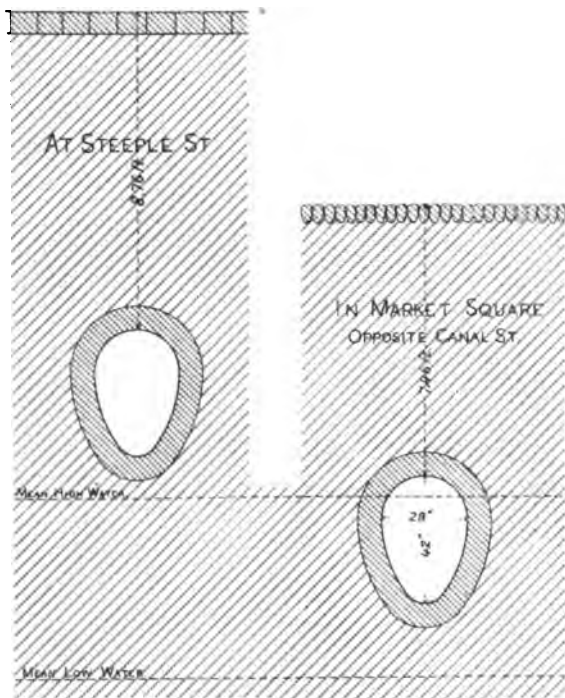


34"x51"

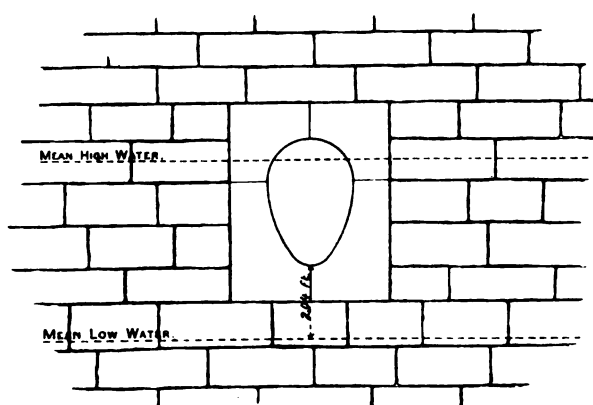


34"x51"

SECTIONS OF SEWERS.
Scale lin. = 4 ft.

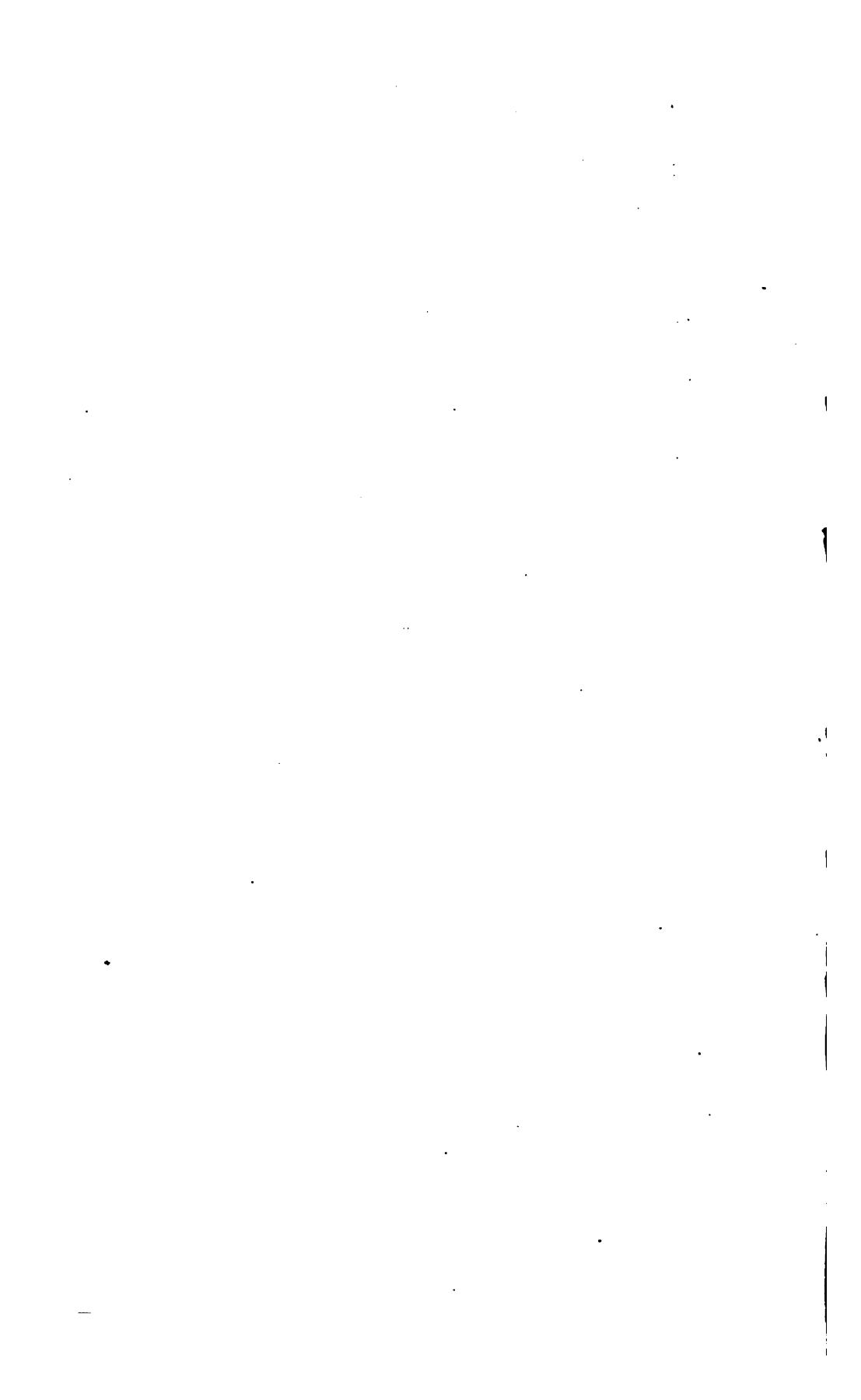


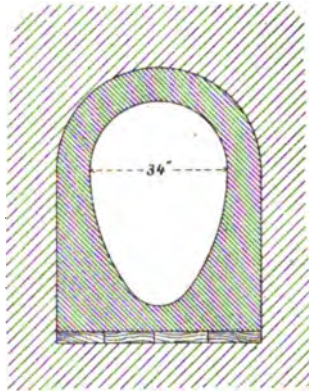
SECTIONS OF NORTH MAIN ST. SEWER.



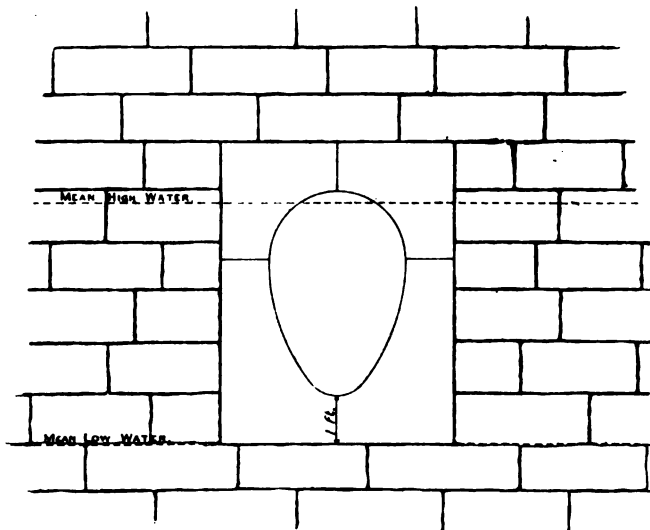
OUTLET OF NORTH MAIN ST. SEWER.

Scale $\frac{1}{4}$ in. = 1 ft.

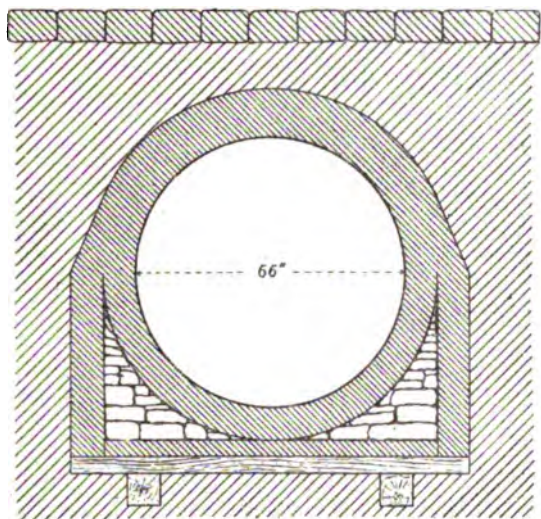




SECTION OF POINT ST. SEWER
NEAR THE OUTLET.



OUTLET OF POINT STREET SEWER.
Scale 1 in = 4 ft.



SECTION OF DORRANCE ST. SEWER

AT DYER STREET.

Scale lin.=4 ft.

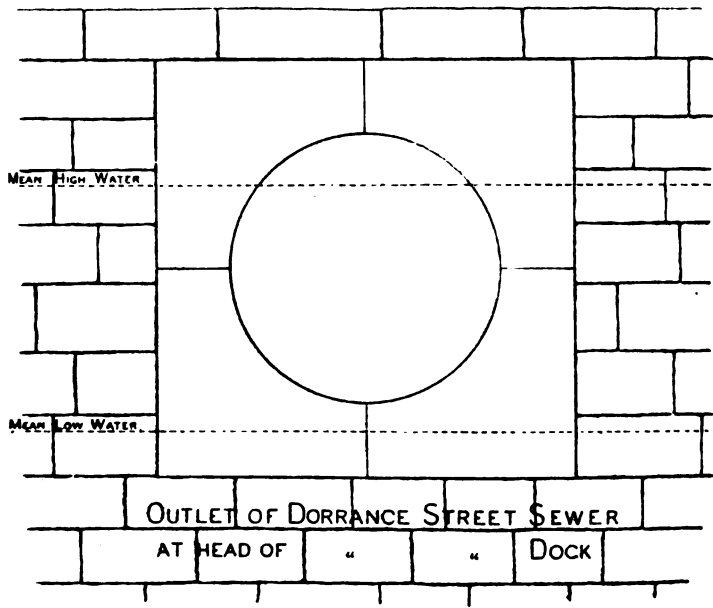
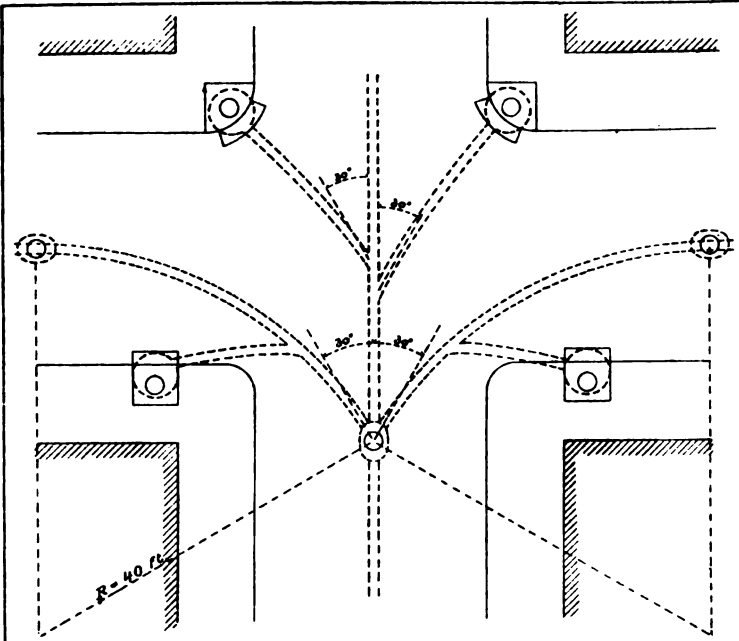
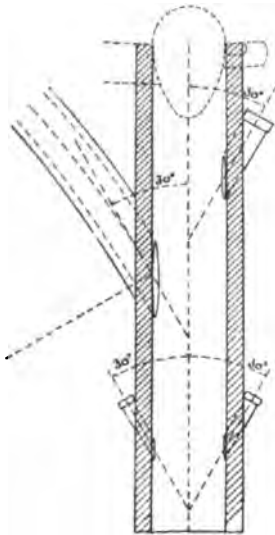




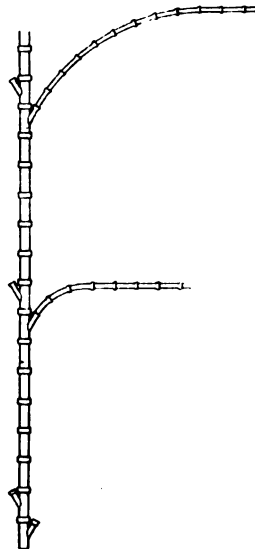
Plate 5.



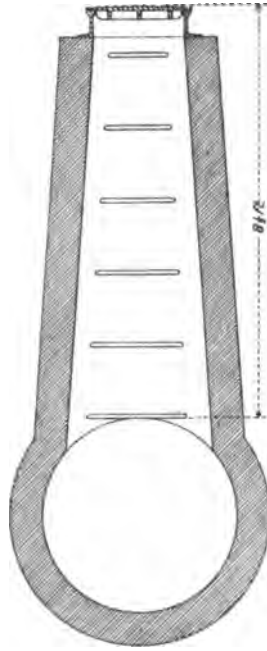
Scale 1 in. = 20 ft.



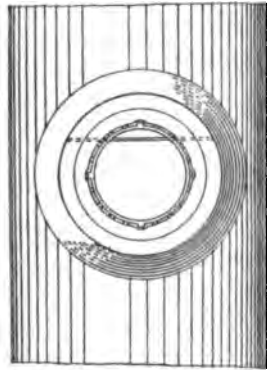
Scale 1 in. = 8 ft.



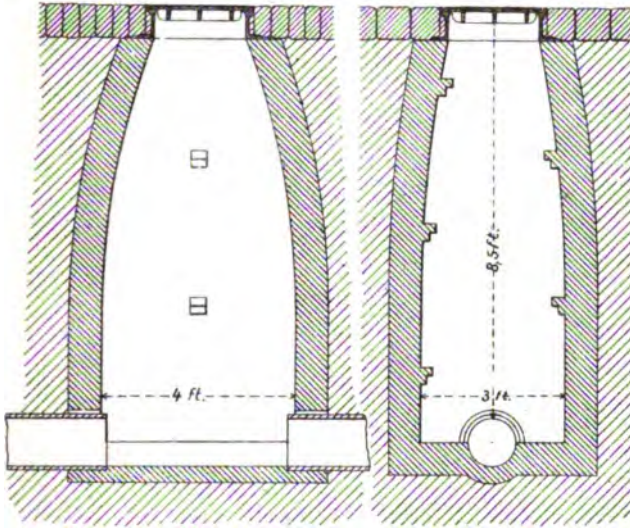
Scale 1 in. = 20 ft.



MANHOLE.
Scale 1 in = 4 ft.

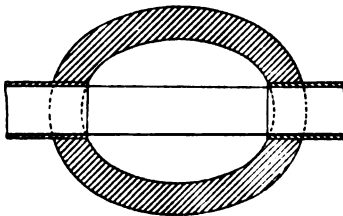






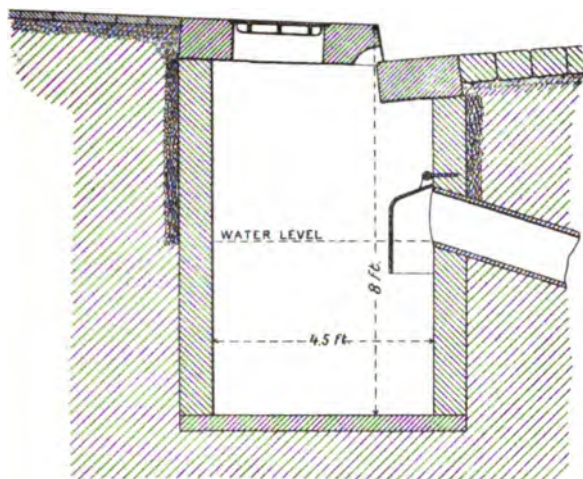
SECTION.

SECTION.

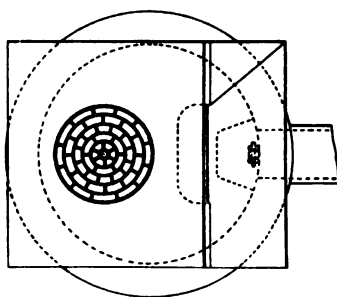


PLAN OF MANHOLE.

Scale 1 in = 4 ft.



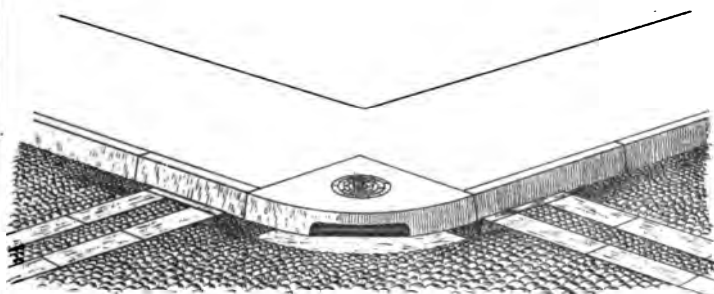
SECTION OF CATCH BASIN.



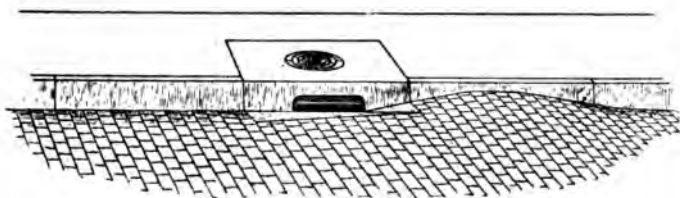
PLAN OF CATCH BASIN.

Scale 1 in. = 4 ft.



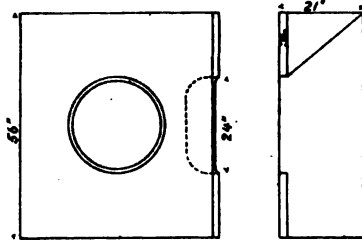
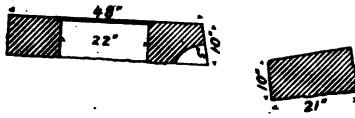


CORNER CATCH BASIN.

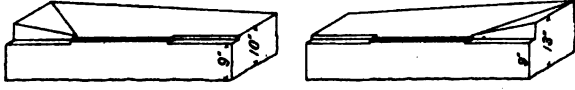


PLAIN CATCH BASIN.

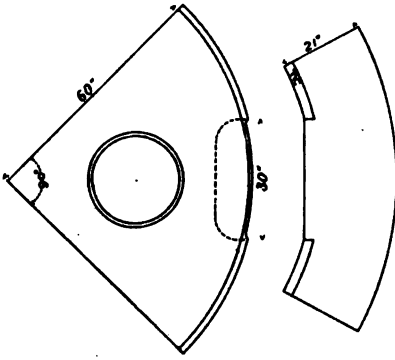
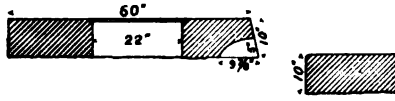




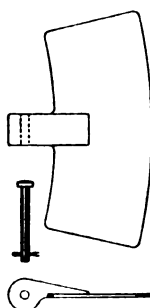
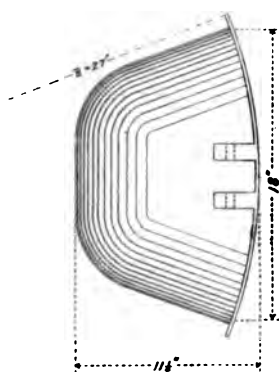
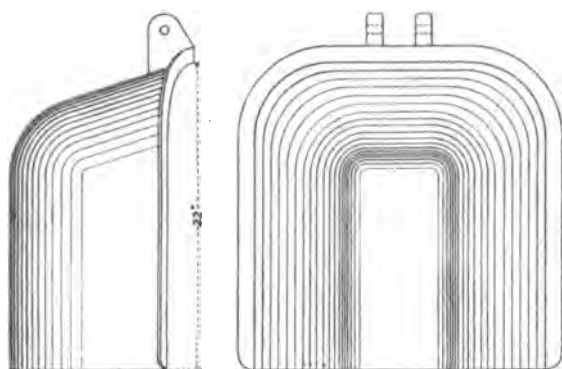
PLAIN COPING AND GUTTER STONES.



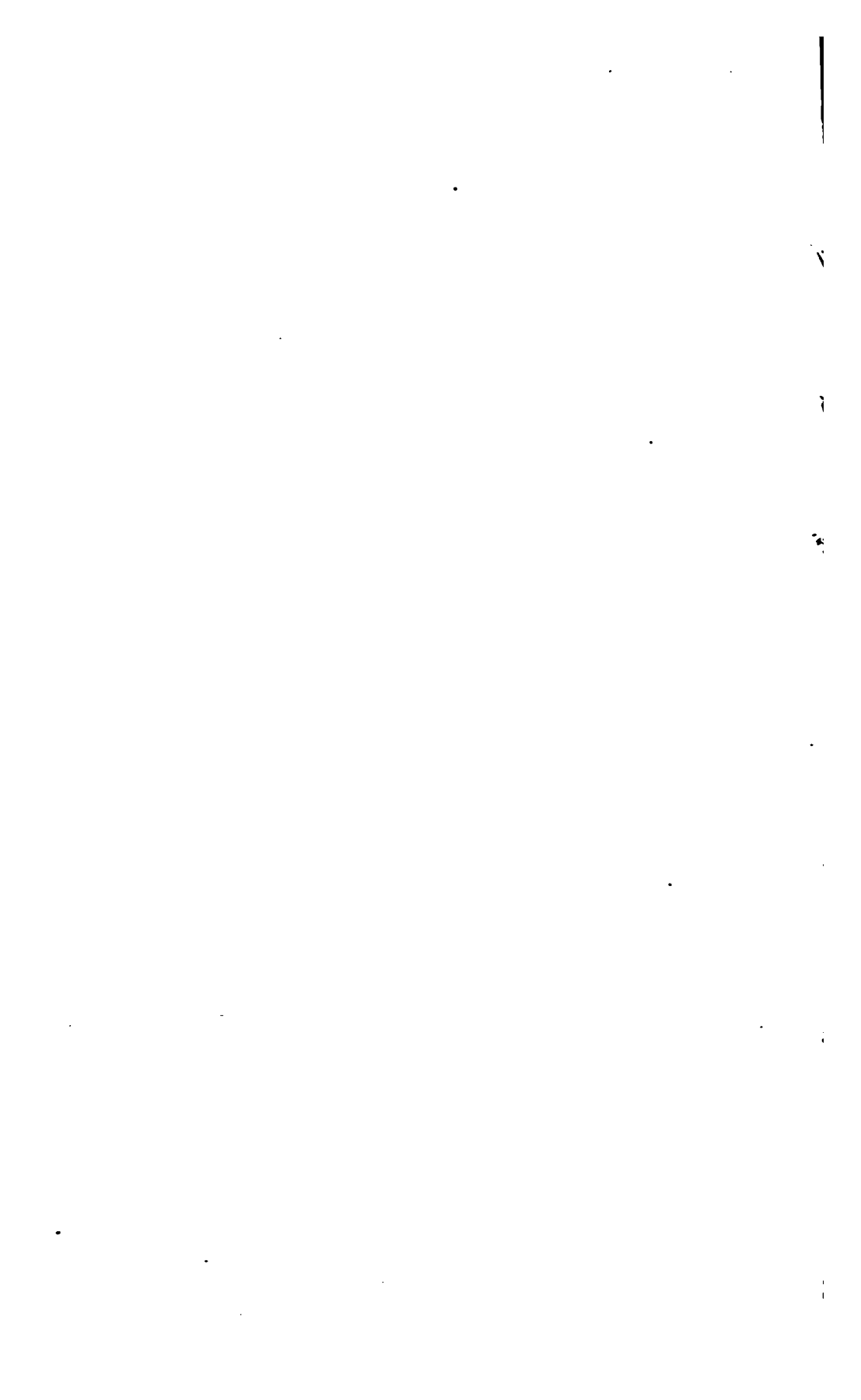
Right and Left Gutter stones.

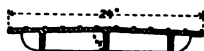
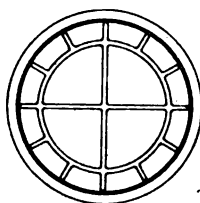


CORNER COPING AND GUTTER STONES.
Scale lin=4ft.

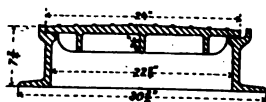
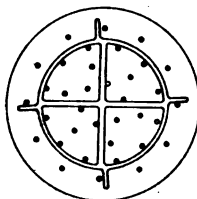
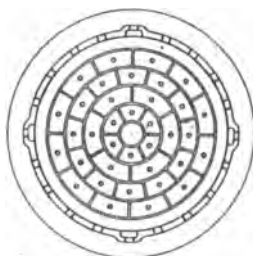


CATCH BASIN TRAP.
Scale 1 in = 1 ft.

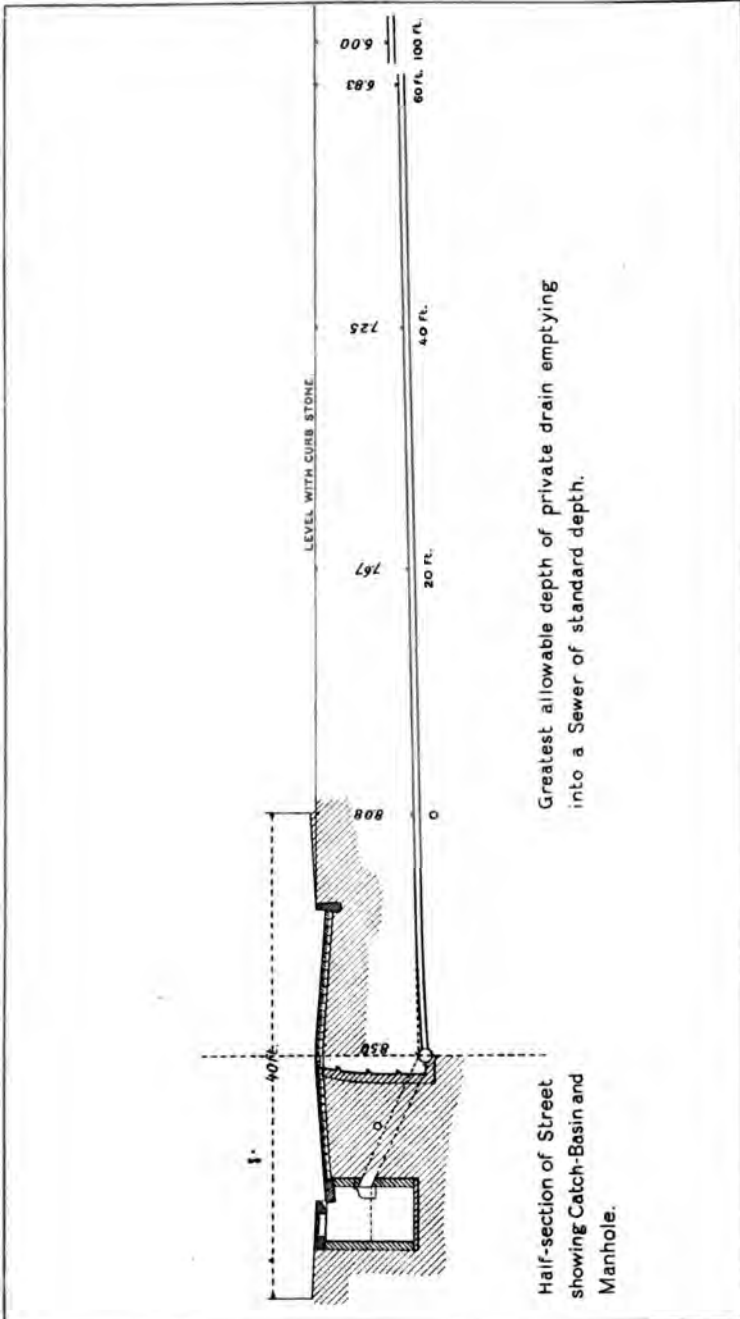


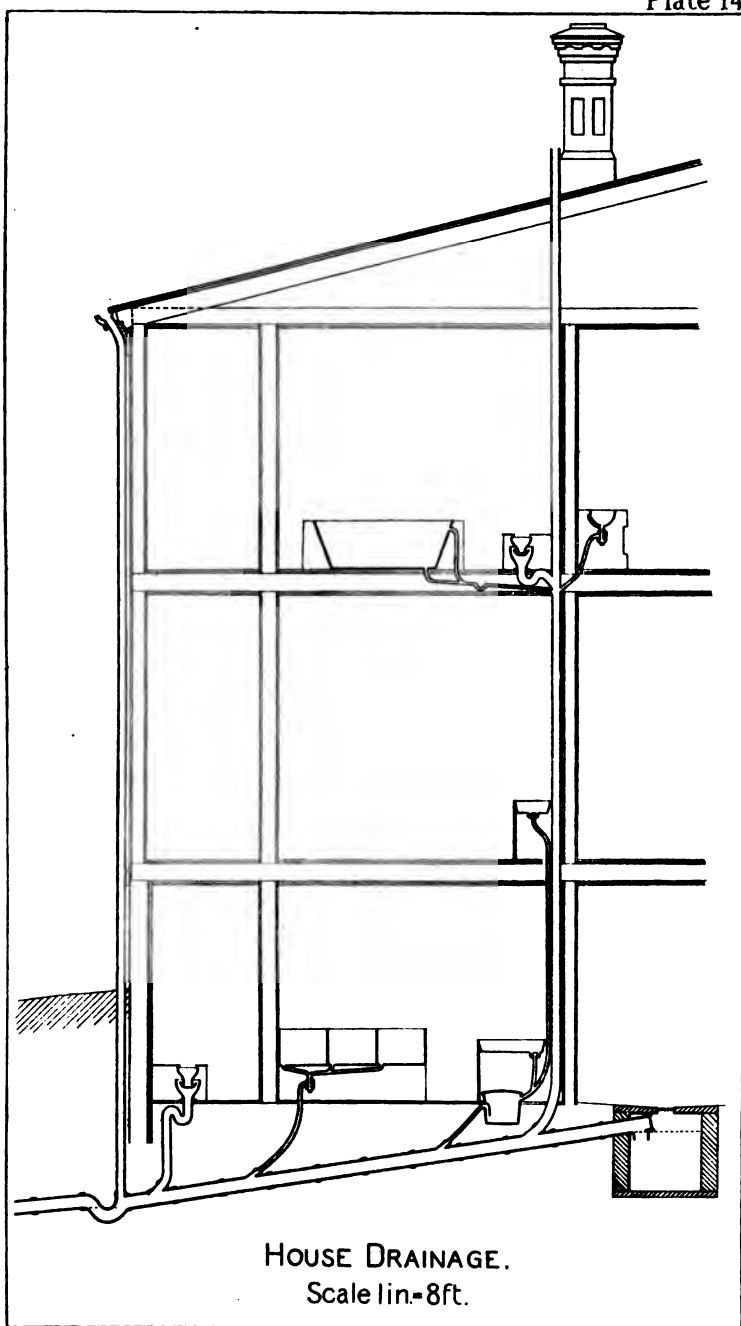


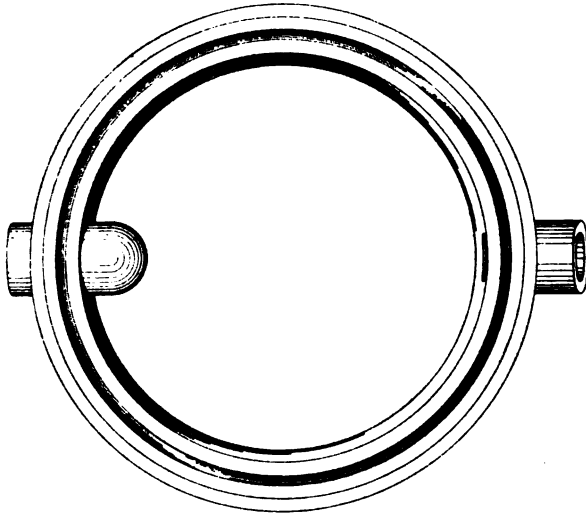
CATCH BASIN COVER.



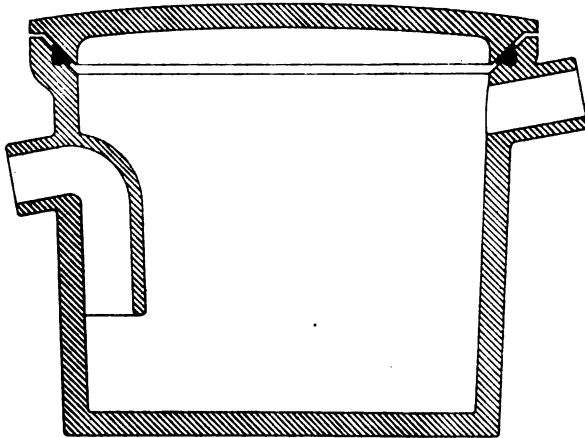
MANHOLE FRAME AND COVER.
Scale 1 in. = 2 ft.

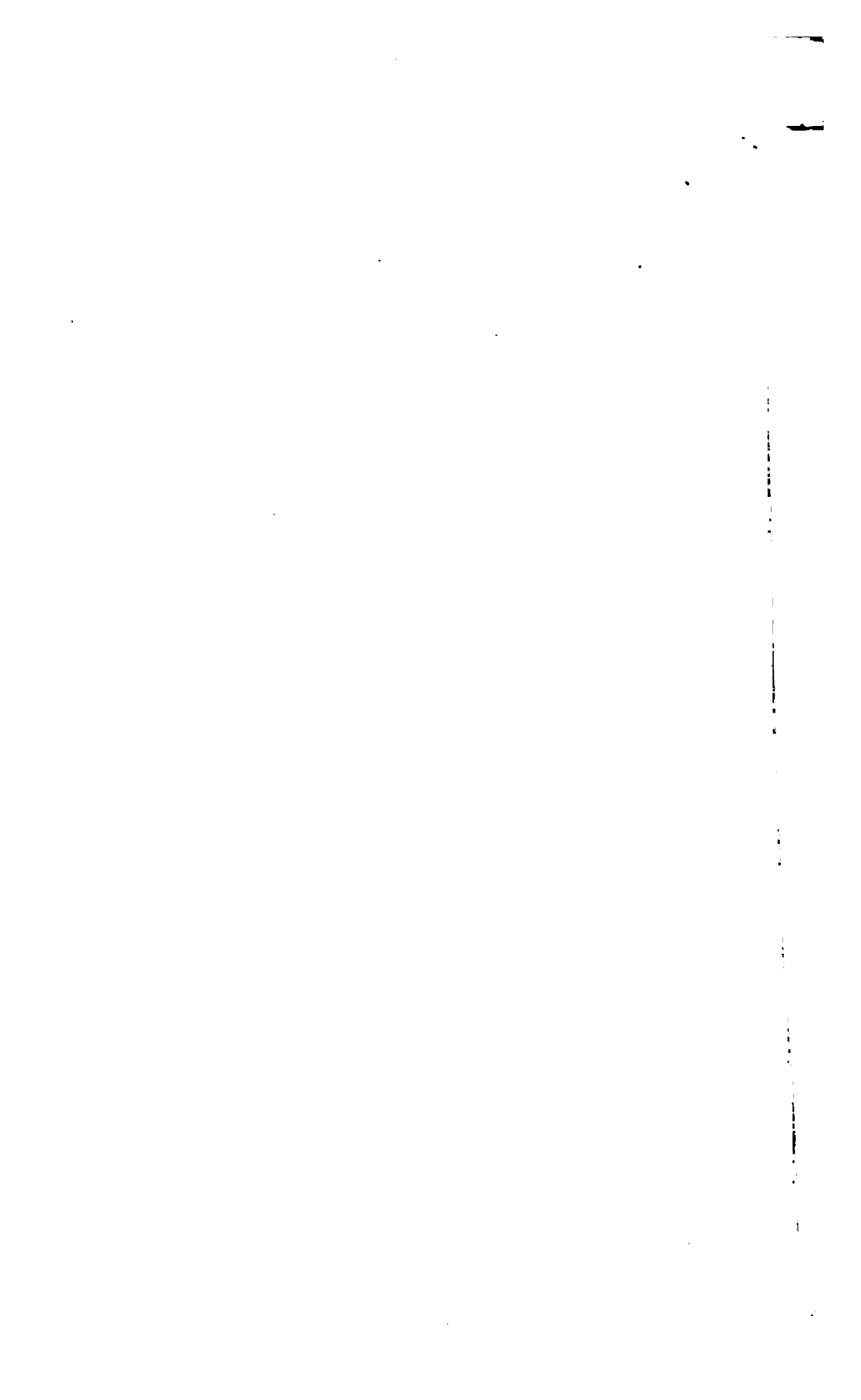


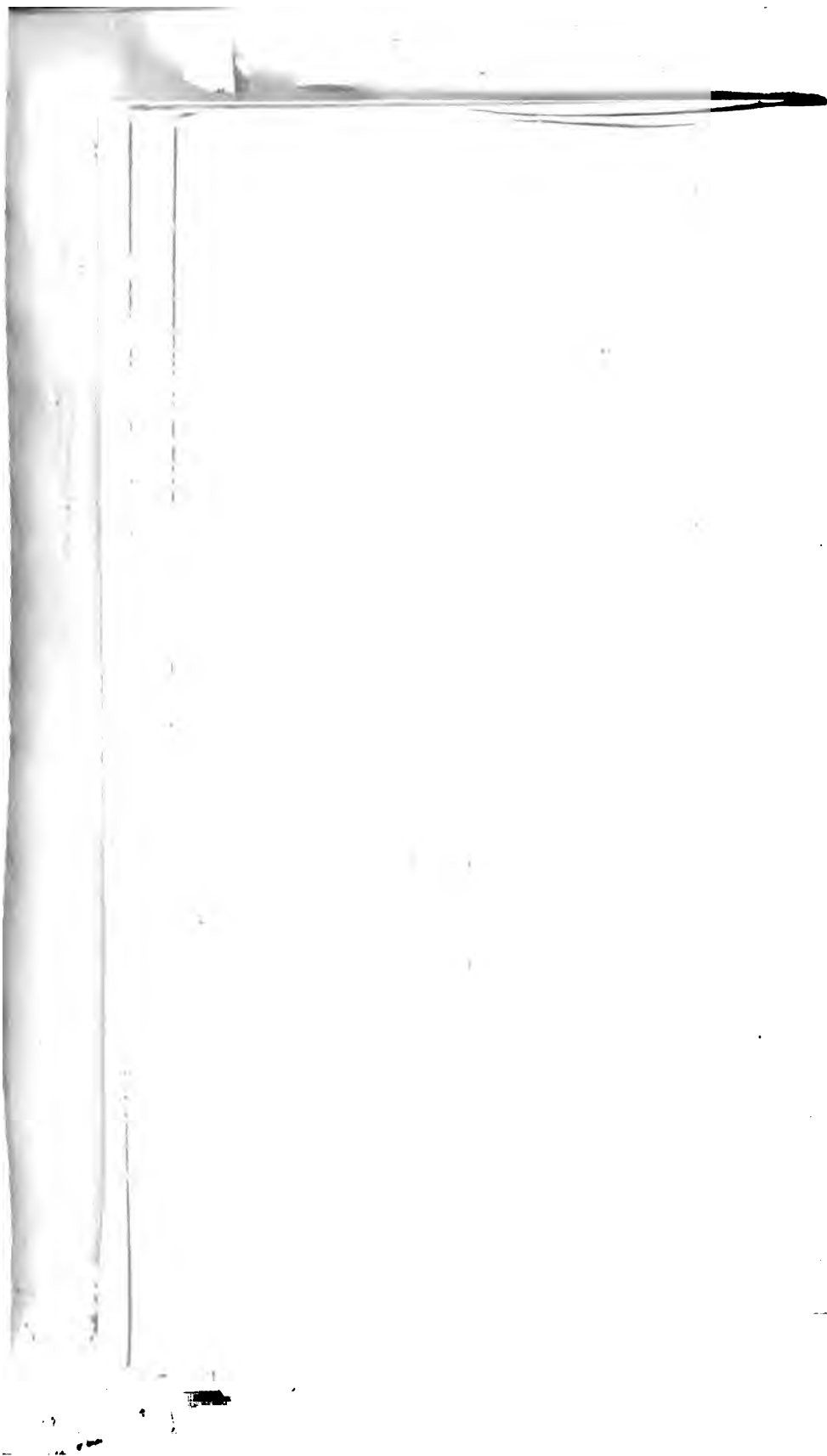




GREASE TRAP
Made of Stoneware.
Scale 1 1/2 in - 1 ft.









APPENDIX.

Stat

20 in.
x
45 in.

Statutes.

						TOTAL.	TOTAL.	COST OF SEWERS.
30 in. x 45 in.	32 in. x 48 in.	34 in. x 51 in.	36 in. x 54 in.	38 in. x 57 in.	40 in. x 60 in.	Length of Street.	Length of Sewer.	
.....	3,703.00	3,703.00	\$12,328.50
.....	2,508.00	3,019.00	22,046.62
.....	1,322.25	1,376.25	4,456.51
.....	504.50	.....	.....	.....	1,585.50	1,679.00	13,550.26
.....	1,057.22	1,259.72	6,109.80
.....	1,392.43	1,482.43	7,381.27
.....	1,275.05	1,275.05	4,906.96
.....	508.67	539.67	2,113.90
.....	168.08	168.08	506.19
.....	216.75	216.75	635.21
.....	754.51	825.51	5,811.30
.....	561.15	561.15	2,330.29
.....	845.03	807.53	4,807.12
.....	341.85	341.85	1,806.55
.....	781.04	814.54	4,117.89
.....	682.34	700.34	5,498.42
.....	754.15	816.15	4,018.25
.....	1,827.40	2,005.40	14,912.80
.....	616.59	616.59	2,380.61
.....	1,534.06	1,534.06	7,147.53
.....	302.44	302.44	1,150.94
.....	1,270.33	1,379.33	8,536.37
.....	400.45	400.45	1,850.29
.....	1,166.09	1,246.09	9,688.36
.....	900.23	919.23	3,886.34
.....	772.41	772.41	3,941.00
.....	306.82	306.82	1,713.00
.....	219.30	219.30	448.15
.....	150.04	150.04	761.79
.....	320.02	357.22	2,302.79
.....	200.40	200.40	945.94
.....	813.11	902.61	5,366.77
.....	646.83	646.83	3,151.39
.....	226.90	226.90	1,341.62
.....	425.73	425.73	2,119.23
.....	1,026.89	1,064.94	7,480.10
.....	1,111.37	1,194.37	7,706.89
.....	1,159.60	1,159.60	5,801.92
.....	1,302.62	405.20	.....	.....	2,221.25	2,314.25	45,081.93
.....	1,562.60	1,754.60	.....
.....	3,010.51	3,111.41	21,356.04
.....	700.54	835.29	5,008.28
.....	1,802.71	.....	2,354.46	.....	5,082.82	5,234.06	85,966.45
.....	329.44	329.44	.....
.....	978.17	996.17	.....
.....	458.53	458.53	.....
.....	2,647.79	2,830.79	.....
.....	1,581.00	1,500.00	.....
.....	681.29	681.29	.....
.....	1,016.20	1,076.20	.....
.....	184.46	184.46	.....
.....	508.83	539.83	.....
.....	391.90	391.90	.....
.....	594.50	3,035.33	405.30	2,354.46	55,076.20	57,874.90	\$353,318.98
.....	10.42 mls.	10.96 mls.	Cost so far as reported.

APPLICATION FOR PRIVATE DRAINS.

The following Rules, and Form of Application and Agreement, were adopted by the Board of Aldermen May 12, 1873.

1. Applications for permits to connect with any sewer which has been constructed, or which is in process of construction, by a Committee appointed by the Board of Aldermen, must be made in writing to the Water Commissioners by the owners of the property to be drained, or by their duly authorized attorneys, and must be accompanied by a clear description of the premises to be drained, and of the drains required, and also by certain agreements, all as provided in the printed form of application issued by said Commissioners.

2. No one but a drain-layer duly licensed by the Water Commissioners will be allowed to make connections with the public sewers named in the above section, nor lay any drains in connection therewith.

3. At least twenty-four hours' notice must be given at the office of said Commissioners before any street or public way can be opened for the purpose of laying a private drain.

4. No drain-pipe can be extended from work previously done and accepted, or new connections of any kind be made with such work, unless previous notice of at least twenty-four hours is given to the Engineer in charge of private drains.

5. No work of laying drains can be commenced or continued unless the permit is on the ground, in the hands of the drain-layer, or some one employed by him.

RULES FOR LAYING DRAINS.

1. In opening any street or public way, all materials for paving or ballasting must be removed with the least possible injury or loss of the same, and, together with the excavated material from the trenches, must be placed where they will cause the least practicable inconvenience to the public. As little as possible of the trench must be dug until the junction-piece into the sewer is found, unless it is first determined to make a new opening into the sewer.

2. Whenever the sides of the trenches will not stand perpendicular, sheeting and braces must be used to prevent caving.

3. No pipes or other materials for the drains can be used till they have been examined and approved by the Chief Engineer or by one of his Assistants, or by a duly-authorized Inspector.

4. The least inclination that can be allowed for water-closet, kitchen, and all other drains of not over six inches diameter, liable to receive solid substances, is one-half an inch in two feet; and for cellar or other drains, to receive water only, one-quarter of an inch in two feet. All drains to be laid at a grade of not over one-half an inch in two feet, between the sewers and the sidewalks.

5. The ends of all pipes not to be immediately connected with water-closets, sinks, down-spouts, or catch-basins, are to be securely guarded against the introduction of sand or earth by brick and cement, or other water-tight and imperishable materials.

6. All pipes that must be left open to drain cellars, areas, yards, or gardens, must be connected with suitable catch-basins of brick, the bottoms of which must not be less than two and a half feet below the bottom of the outlet pipe, the diameter not less than three feet, and the form and construction of which are to be prescribed by the officers named in the third rule. When meat-packing-houses, slaughter-houses, lard-rendering establishments, hotels, or eating-houses, are connected with the sewers, the dimensions of the catch-basins will be required to be of a large size, according to the circumstances of the case. When the end of the drain-pipe is connected with a temporary wooden catch-basin for draining foundations during the erection of buildings, the drain-layer will be held responsible that no dirt or sand is carried into the drain or sewer from such temporary catch-basin.

7. No private catch-basin can be built in the public street, but must be placed inside of the line of the lot to be drained, except when the sidewalks are excavated, and used as cellars.

8. No privy-vaults can be connected with the sewers except through an intervening catch-basin; and the discharge-pipe of the vault must be high enough above its bottom to effectually prevent any thing but the liquid contents of the vault from passing into the drain.

9. The inside of every drain, after it is laid, must be left smooth and perfectly clean throughout its entire length.

10. In case it shall be necessary to connect a drain-pipe with a public sewer where no junction is left in such sewer, the now con-

nection with such sewer can only be made either by one of the employés of the Commissioners, or when an officer named in rule third is present to see the whole of the work done.

11. Whenever it is necessary to disturb a drain in actual use, it must in no case be obstructed without the special direction of one of the officers named in rule third. No pipe-drain can be laid above the bottom of a wooden drain, whether in actual use or not, unless the pipe is made to rest either on brick or stone, or other suitable support. In no case will drain-pipes be allowed to rest on wood or other perishable material.

12. The back-filling over drains, after they are laid, must be puddled, and, together with the replacing of ballast and paving, must be done within forty-eight hours after the completion of that part of the drain lying within the public way, and done so as to make them at least as good as they were before they were disturbed, and to the satisfaction of the Commissioners and their Engineer; and the owner will be held responsible for any subsequent settlement of the ground. All water and gas pipes must be protected from injury or settling to the satisfaction of the Engineer.

13. Every drain-layer must enclose any opening which he may make in the public streets or ways, with sufficient barriers; and must maintain red lights at the same at night; and must take all other necessary precautions to guard the public effectually against all accidents, from the beginning to the end of the work; and can only lay drains on condition that he shall use every precaution against accidents to persons, horses, vehicles, or property of any kind.

14. In case a water or gas pipe should come in the way of a drain, the question of passing over or under the water or gas pipe, or of raising or lowering it, must be determined by one of the officers named in rule third. In no case can the drain-layer be allowed to decide the question himself.

15. No exhaust from steam-engines can be connected with the private or public drains, and no blow-off from steam-boilers can be so connected, without special permission from the Commissioners or their Engineer.

16. Such information as the Commissioners have with regard to the positions of junctions will be furnished to drain-layers, but at their risk as to the accuracy of the same.

17. When any change of direction is made in the pipe, either in a horizontal or vertical direction, curves must be used. No pipe can be clipped in any case.

18. All persons are required to place an effectual trap in the line of drain just before it leaves the premises, and to make an open connection with a down-spout back of the trap; also to make an open connection with the highest part of the soil-pipe within the premises, through a large pipe or flue, to a point above the roof of the building.

19. Every person violating any of the provisions of the foregoing rules shall pay a fine of not less than twenty nor more than fifty dollars.

PRIVATE DRAINS.

PROVIDENCE,187

To the Water Commissioners:—

The undersigned appl for permission to lay.....House
 Drain from premises No. Street,..... side,
feet from..... Street, having a front of.....
 feet, and an area of.....feet, owned by..... for
 the purpose of draining

..... Water Closets,

..... Sinks,

.....,
 and to connect the same with the public sewer in
 Street; and, in consideration that permission shall be granted.....
 to connect said estate with said sewer, the undersigned hereby
 agree to execute the work on such drain and its appurtenances in
 strict conformity to the laws and ordinances relating thereto, and
 to the rules and regulations of the Water Commissioners, and un-
 der the directions of their Engineer. And the undersigned further
 agree that no claim for damages which may be occasioned to such
 estate, or any property thereon, in any manner, by the construc-
 tion, use, or existence of such drain or connection, shall be made
 against the city. And the undersigned further agree that if, from
 any cause, the Commissioners deem it necessary to do any work in
 making such connection, or in restoring the street to a proper con-
 dition, they shall have the right so to do; and the cost of any such
 work, done under the direction of said Commissioners, and certi-
 fied by them, shall be paid by.....on demand, and shall be
 a lien upon said estate, and, if not paid within ten days after
 demand, may be added with interest to the city taxes upon said
 estate, and collected as other city taxes are collected.

.....

Permit No.

OFFICE OF THE WATER COMMISSIONERS,
 PROVIDENCE,.....187

The Water Commissioners hereby authorize.....
 to execute the above work on the conditions above specified.

DRAIN-LAYER'S RETURN.

Permit No.

For..... House Drain, from premises No.
 Street,..... side.....
 feet from Street, owned by.....
 for the purpose of draining

..... Water Closets,
 Sinks,

The drain connects with the public sewer in.....
 Street, feet of the manhole, and is
 feet in length.

I hereby certify that the above connection was properly made by
 me, on the day of 187 , without opening,
 or in any way injuring, the main sewer ; that said drain was laid to
 a true and proper grade, and constructed of sound and substantial
 pipe, with joints properly cemented and tight, and connected with
 traps and catch-basins properly constructed ; and that the whole
 was left clean and in good condition, all in strict conformity with
 the rules of the Board of Aldermen.

.....
Drain-Layer.

I hereby certify that the above work was inspected by me, and
 that it was properly done. A diagram of the same, made by me, is
 in Note-Book No. p.

.....
Engineer of Private Drains.

PROVIDENCE, 187 .

CITY OF PROVIDENCE.

RESOLUTION OF THE CITY COUNCIL.

No. 301. — RESOLUTION EMPOWERING THE WATER COMMISSIONERS TO ALLOW CONNECTIONS WITH THE SEWERS BY OTHERS THAN ABUTTERS.

(Approved Nov. 10, 1873.)

Resolved, That the Water Commissioners be and they are hereby authorized to allow connections to be made with sewers which have been constructed, or which may hereafter be constructed, under the direction of committees appointed by the Board of Aldermen, or by the Water Commissioners, by persons whose estates do not abut on the street in which such sewer is laid, on such terms as said Water Commissioners may prescribe.

CITY OF PROVIDENCE.

BOARD OF ALDERMEN.

RULES AND REGULATIONS RELATIVE TO THROWING REFUSE MATTER INTO THE STREET-OPENINGS TO SEWERS.

(Passed Oct. 23, 1873.)

1. No person shall at any time place or deposit in any street-opening to any sewer any animal or vegetable matter whatever, solid or liquid, or any other filthy substance.
2. Any person violating any of the provisions of the foregoing rule and regulation shall pay a fine of not less than ten nor more than twenty dollars for each offence.

Extract from Chapter 813 of the Acts and Resolves of the General Assembly of the State of Rhode Island and Providence Plantations, January Session, 1873.

SECTION 3. — The said city council may, by ordinance, confer upon said Board all the authority conferred upon and given to said city by chapters 640 and 784 of the statutes; also all the powers now by law vested in surveyors of highways or highway commissioners; also the power to make all assessments authorized to be made under the provisions of chapters 807 and 931 of the statutes, and of this Act, for the payment of the cost of the construction of sewers already built, or which may be hereafter built, under the provisions of said chapter or this Act.

SECT. 4. — All such assessments shall be made upon all estates abutting upon that portion of any street or highway in which any sewer has been or may be constructed, under the provisions of said chapters and of this Act, at the rate of sixty cents for each front foot of such estates upon such street or highway, and one cent for each square foot of such estates between such street or highway, and a line not exceeding one hundred and fifty feet distant from and parallel with the line of such street or highway; provided, however, that, where any estate is situated between two streets or highways, the area upon which such assessment of one cent per square foot is made shall not extend to more than one-half the distance between such streets or highways; and provided also, that where any estate is situated at the corner of two streets or highways, or otherwise so situated as to be assessed for the expense of making a sewer in one of such streets or highways, that portion of such estate assessed for a sewer in one of such streets or highways shall not be liable to be assessed upon its area for the cost of constructing a sewer in the other of such streets or highways, but only for its frontage upon such street.

SECT. 5. — When any such assessment shall be made upon any land for the expense of constructing any such sewer, the owner of the land so assessed shall have the right to connect such land with such sewer under such general rules and regulations as said Board of public works shall prescribe, upon executing to said city a

release of all damages which may at any time happen to such estate in any way resulting from such connection.

SECT. 6. — All assessments made under the authority of this Act shall be a lien upon the estates upon which they are made, for one year from the date upon which they are certified by said Board to the city treasury for collection ; and shall be collected as the ordinary taxes of the city are collected.

CITY OF PROVIDENCE.

AN ORDINANCE CONFERRING CERTAIN POWERS UPON THE WATER COMMISSIONERS.

(Approved July 3, 1873.)

IT IS OBTAINED BY THE CITY COUNCIL OF THE CITY OF PROVIDENCE AS
FOLLOWS:—

SECTION 1. — The water commissioners, until an election shall be made of the board of public works, shall have, subject to the control of the city council, the general charge and management of the construction, reparation, and maintenance of all common sewers and drains, whether laid in public streets or through private property.

SECT. 2. — All the authority given to the city, under the provisions of chapters 807, 931, and 313 of the statutes, to make assessments for the payment of the cost of the construction of sewers already built, or which may be hereafter built, under the provisions of said chapters, or either of them, is hereby conferred upon the water commissioners, who shall exercise such authority until an election of a board of public works shall be made.

The plates are reproduced and printed by the Heliotype process, from our drawings, by Messrs. JAMES R. OSGOOD & Co. of Boston. They will undoubtedly excite much interest as specimens of this new process for reproducing illustrations.

1873-74.

MASS. STATE BOARD OF HEALTH,
CITY DOCUMENT No. 60.

ENGINEER'S OFFICE.

THIRD REPORT

OF THE

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE,

ON

SEWERS,

FEBRUARY 28, 1874.



PROVIDENCE:

HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.

1874.

1873-74.

CITY DOCUMENT.

No. 60.

THIRD REPORT
OF THE
WATER COMMISSIONERS
OF THE
CITY OF PROVIDENCE,
ON
SEWERS,

FEBRUARY 28, 1874.



PROVIDENCE:
HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.
1874.

ORGANIZATION
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT.

CHARLES E. CARPENTER,

WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.

Office No. 35 North Main street.

CHIEF ENGINEER.

J. HERBERT SHEDD.

Office No. 35 North Main street.

REPORT.

OFFICE OF THE WATER COMMISSIONERS, }
PROVIDENCE, February 28th, 1874. }

TO THE HONORABLE THE CITY COUNCIL:

The undersigned, Water Commissioners, respectfully present their third report on Sewers:

In their second report on Sewers, January 1, 1874, the Commissioners gave a list of Sewers, ordered by the Honorable the Board of Aldermen, to be constructed by Committees constituted by said Board, under the provisions of Chapter 807 of the Revised Statutes, upon which no report had been made by said Committees. Reports in detail have since been made to the Board of the construction of the following Sewers:

From Atwell's avenue, through Bourn street, Broadway, Carpenter, Jackson, High, Chestnut and Elm streets to the river; cost \$85,956.45.

Pearl street, from Broad street to Mumford street; cost \$45,081.93.

Williams street, from East street, through Governor, Bower and Ives streets, and land of Union Oil Co., to the river; cost \$21,356.04.

North Main street, from foot of Constitution Hill to Olney street; cost \$7,706.89.

Hospital street, from a Point near Lake street to Langley street,

and through Langley street and Eddy street to Manchester street ; cost \$7,480.10.

Benevolent street, from Cooke street to Governor street, and in Governor street to Williams street ; cost \$5,891.92.

In Weybosset and Westminster streets, from the summit near the Arcade to the river ; cost \$5,608.28.

The following Sewer has been completed, but no report has yet been made :

Dorrance street, from Westminster street to the river.

By a resolution of the City Council, approved January 15, 1874, so much of resolution 596 as requests the Board of Aldermen to cause a Sewer to be constructed in Weybosset street, from the summit near the Arcade to Dorrance street, and in Westminster street, from Dorrance street to Exchange street, was repealed, and by another resolution, approved the same day, the Water Commissioners were directed to cause the same to be constructed.

The following Sewers ordered by the City Council to be constructed under the direction of the Water Commissioners, in accordance with the provisions of chapter 313 of the statutes, are in a state of progress, as follows :

Cooke street, from a point near Young Orchard avenue to Power street, and through Power street to Ives street, one catch-basin, with connection, remains to be built.

Ives street, from Pitman street to Bower street, 8 catch-basins, with connections, to be built.

Power street, from Brown street to Benefit street, a distance of 140 feet, has been constructed.

The following Sewers have also been ordered by the City Council :

Aborn street, from Washington street to Westminster street ; not commenced. Waiting for the new sewer which has been ordered to be constructed in Westminster street for an outlet.

Benefit and Wickenden streets, from Williams street to Brook

street, not commenced. Waiting for the construction of Brook street sewer.

Westminster street, from *Jackson street* to *Dorrance street*, not commenced. Waiting for spring weather.

Thayer street, from *Bowen street* to *Angell street*, and through *Angell and Brook streets* to the river ; not commenced. Waiting for the completion of the grading of Brook street.

Broadway, from *Almy street* to *Jackson street* ; not commenced. Waiting for spring weather.

Power street, from *Benefit street* to *South Main street* ; not commenced. Waiting for the opening of spring.

The following Sewers were ordered by the City Council, 26th February, instant:

Richmond street, from *Broad street* to *Pine street*.

Pitman street, from *Ives street* to *Gano street*.

Broad street, from *Stewart street* to *Chestnut street*.

Congdon street, from *Bowen street* to *Angell street*.

Prospect street, from *Jenckes* to *Meeting streets* and through *Meeting* to *Thayer street*.

The accounts in relation to the following completed Sewers are not yet in readiness for a statement of cost:

Clifford street, from *Plane street* to *Chestnut street*.

Meeting street, from *Prospect street* to *Congdon street*.

High street, from *Batley street* to *Westminster street*.

Elm street, from *Plane street* to *Chestnut street*.

George street, from *Cooke street* to *Governor street*, thence in *Governor street* to *Benevolent street*.

Bassett street, from *Elm street* to *Chestnut street*.

Burr's lane, from the head of the lane to *North Main street*.

Chestnut street, from *Elm street* to *Point street*.

John street, from *East street* to *Governor street*.

Young Orchard avenue, from *Cooke street* to *Governor street*.

Two Drain Layer's licenses have been issued during the last two months, as follows:

Michael Connelly, Solomon Thornton.

The total number of such licenses issued to date is 24.

A schedule of Sewer bills, approved by the Water Commissioners, from January 1, 1874, to February 28, 1874, inclusive; a trial balance of the Water Commissioners' Ledger, Sewer Department, February 28, 1874, inclusive; a trial balance of the Ledger of the Committees appointed by the Board of Aldermen to build certain sewers, February 28, 1874, inclusive; and a schedule of receipts by the Water Commissioners, Sewer Department, and paid to the City Treasurer, from January 1, 1874, to February 28, 1874, inclusive: are hereunto appended and made parts of this report.

JOSEPH J. COOKE,	}	<i>Water</i>
CHAS. E. CARPENTER,		
WILLIAM CORLISS,		
		<i>Commissioners.</i>

REPORT ON SEWERS.

9

SCHEDULE OF BILLS APPROVED BY THE WATER COMMISSIONERS, SEWER DEPARTMENT, FROM JANUARY 1, 1874, TO FEBRUARY 28, 1874, INCLUSIVE.

257	Alfred Mundell, on account of constructing sewer in High street, from Battey to Westminster street, - -	\$1,329 17
258	H. B. Leach & Sons, on account of constructing sewer in George and Governor streets, - -	197 59
259	H. B. Leach & Sons, on account of constructing sewer in Cooke and Power streets, - -	727 49
260	Charles H. Pierce, paid by him for labor cleaning catch-basins, &c.,	320 00
261	Charles H. Pierce, paid by him for labor on sewers, &c., -	735 77
262	Charles H. Pierce, paid by him for sundries, -	26 33
263	Alfred Mundell, paving around manholes, raising gutters, &c., sewer in High street, - -	32 93
264	Alfred Mundell, tools, &c., - -	78 13
265	Not used.	
266	G. Walter Smith, cutting catch-basin stones, - -	83 60
267	William H. Miller & Co., repairing tools, &c., - -	20 02
268	Grant Brothers, repairing tools, &c., - -	31 92
269	Henry W. Ellis, repairing tools, &c., - -	83 56
270	Thomas M. S. Williams, repairing pump, - -	6 50
271	Thomas M. S. Williams, galvanized iron pump, &c., -	15 75
272	John Mason, sewer model, &c., - -	20 07
273	James Moran, oil, candles, &c., - -	7 39
274	Providence and New York Steamship Co., freight of sewer pipe, -	56 36
275	George W. Hall & Co., cement, - -	70 00
276	Hopkins & Pomroy, cement, carting bricks, &c., -	109 80
277	William S. Briggs, horse hire by engineers, - -	72 00
278	Hammond Angell & Co., printing, - -	141 72
279	William Nelson, Jr., sewer pipes, - -	576 00
280	Stephen Knobb, carting catch-basin stones, - -	147 14
281	George W. Smith, cutting curb, &c., - -	9 50
282	Allen Aldrich, horse hire, &c., - -	19 10
283	Charles F. Pope, powder and fuse, - -	6 04
284	William H. Fenner & Co., sauce pans, - -	4 80
285	R. K. Randolph, horse hire, &c., - -	11 00
286	Henry L. Ripley, salary as engineer, private drains, -	100 00
287	George Bowers, salary as inspector of catch-basin stones, -	108 00
288	Duty J. Greene, salary as inspector on sewer on High street, -	108 00
289	Foster S. Dennis, Jr., salary as inspector on sewer in Young Orchard avenue, - -	52 00
290	Joseph P. Healy, salary as inspector on sewer in High street, -	20 00
291	William Whittaker, salary as inspector on sewer in Fountain and Cove streets, - -	21 29
292	William Whittaker, examining sewers, &c., - -	21 29
293	Frank U. Carter, testing cement, - -	60 75
294	Albert E. Fuller, time-keeper, - -	56 00
295	Allen Aldrich, salary as superintendent of cleaning and repairs, - -	85 00
Amount carried forward - -		\$5,522 01

	Amount brought forward,	-	-	-	\$5,522 01
296	George W. Mitchell, salary as assistant superintendent of cleaning and repairs,	-	-	-	117 00
297	N. Webber, rubber boots,	-	-	-	6 00
298	Albert Dailey & Co., lumber,	-	-	-	71 02
299	James Phillips & Co., pipe, nipples, couplings, labor, &c.,	-	-	-	9 47
300	A. C. Buchanan, carting tools,	-	-	-	3 50
301	Standard Broom Co., paper bags,	-	-	-	4 00
302	Peck & Salisbury, coal,	-	-	-	4 50
303	George Campbell, repairing tools,	-	-	-	12 15
304	Phenix Iron Foundry, tools,	-	-	-	4 25
305	Atwater & Dennis, tools,	-	-	-	8 70
306	William Elsbree, labor, &c., on sewers,	-	-	-	83 00
307	A. C. Eddy & Studleys, rubber boots, &c.,	-	-	-	109 50
308	Dexter Gorton & Co., shed for storing materials, &c.,	-	-	-	143 52
309	Barker, Whitaker & Co., tools, &c.,	-	-	-	860 80
310	George Bowers, salary as inspector of catch-basin stones,	-	-	-	24 00
311	George W. Mitchell, salary as assistant superintendent of cleaning and repairs,	-	-	-	67 50
312	Duty J. Greene, work on engine, tools, &c.,	-	-	-	36 00
313	G. B. & W. F. Inman, labor, (charged to H. B. Leach & Sons,) -	-	-	-	6 25
314	Charles H. Pierce, paid by him for labor on sewers,	-	-	-	315 83
315	H. G. Macomber, additional work on sewers,	-	-	-	158 86
316	Alfred Mundell, on account of constructing sewer in High street, from Battey to Westminster streets, -	-	-	-	366 89
317	Albert E. Fuller, time keeper,	-	-	-	8 00
318	William Whitaker, salary as inspector on Sewer in Ives street, &c., -	-	-	-	41 94
319	Thomas R. Belcher, salary as inspector of catch-basin stones,	-	-	-	32 26
320	Charles H. Pierce, paid by him for labor cleaning sewers, &c.,	-	-	-	119 23
321	Stephen Knobb, carting catch-basin stones,	-	-	-	90 84
322	William S. Briggs, horse hire by engineers,	-	-	-	9 00
323	William H. Fenner & Co., iron buckets, &c.,	-	-	-	11 74
324	George W. Smith, cutting catch-basin stones, (charged to O. C. Campbell, \$4.75,) -	-	-	-	9 50
325	Allen Aldrich, paid by him for sundries,	-	-	-	8 65
326	French, Mackenzie & Co., tools,	-	-	-	9 67
327	A. Carpenter, manhole frames, covers and catch-basin traps,	-	-	-	369 98
328	Allen Aldrich, salary as superintendent of cleaning and repairs, -	-	-	-	85 00
329	Henry L. Ripley, salary as engineer, private drains,	-	-	-	100 00
330	Allen Fire Department Supply Co., hose, couplings, etc.,	-	-	-	21 69
331	Hopkins & Pomroy, stones,	-	-	-	13 71
332	Stanton Clark, agent, catch-basin stones,	-	-	-	344 00
333	M. D. Copeland, coal, teaming, &c.,	-	-	-	8 05
334	G. & C. P. Hutchins, lanterns, oil, &c.,	-	-	-	60 30
335	Rhode Island Concrete Co., concreting around catch-basins,	-	-	-	10 50
336	Charles H. Pierce, paying laborers, &c.,	-	-	-	103 27

 \$9,382 25

TRIAL BALANCE OF WATER COMMISSIONERS' LEDGER, SEWER DEPARTMENT, FEBRUARY 28, 1874.

Dr

Books, stationery, etc.,	\$39 50
Catch-basin traps,	56 35
Manhole frames and covers,	303 63
Catch-basin stones,	650 78
Sewer pipes, rings, covers, &c.,	5,990 98
Bricks,	198 00
Sheet piling,	986 78
Shed for storing materials,	124 31
Superintendence of cleaning and repairs,	506 17
Cleaning and repairing old sewers,	2,566 33
Repairing new sewers,	173 41
Cleaning catch-basins and sewers,	2,705 60
Inspection of connections,	1,388 36
Inspection of catch-basin stones,	284 36
Testing cement,	771 95
Sundries,	31 83
Printing,	113 84
Tools,	4,113 58
Centres, forms, templets, &c.,	66 63
City Treasurer,	388 22
Sewer in Young Orchard Avenue, from Cooke to Governor street,	596 02
“ “ Meeting street, from Prospect to Congdon street,	1,325 88
“ “ Ives street, from Pitman to Bower street,	12,041 35
“ “ Clifford street, from Plane to Chestnut street,	2,431 56
“ “ Elm street, from Plane to Chestnut street,	4,079 65
“ “ John street, from East to Governor street,	569 86
“ “ Bassett street, from Chestnut to Elm street,	2,640 07
“ “ George and Governor streets,	1,688 08
“ “ Burr's lane,	347 73
“ “ Chestnut street, from Elm to Point street,	1,710 11
“ “ Cooke and Power streets,	3,335 76
“ “ High street, from Battey to Westminster street,	6,741 69
“ “ Power street, from Brown to Benefit street,	390 81
Additional catch-basins,	181 59
Additional work on sewers,	239 85
Providence Gas Co.,	10 00
Thomas Pearson,	8 00
Calvin C. Campbell,	7 69
Engineering Department, for horse hire,	299 00
“ “ books, stationery, &c.,	13 74
Engineering Department, for sundries,	45 35
“ “ printing,	55 83
“ “ advertising,	30 00
“ “ labor,	130 77
“ “ instruments	6 89

\$60,806 46

CR.

H. B. Leach & Sons, for Young Orchard avenue,	25 00
" " " George and Governor streets,	97 50
" " " Cooke and Power streets,	180 35
Francis McGrath, for Clifford street, from Plane to Chestnut street,	104 63
Francis McGrath, for Elm street, from Plane to Chestnut street,	161 40
Alfred Mundell, for High street, from Battey to Westminster street,	397 37
Approved bills,	59,840 21

 \$60,806 46

TRIAL BALANCE OF LEDGER, COMMITTEES APPOINTED BY THE BOARD OF
ALDERMEN TO CONSTRUCT CERTAIN SEWERS, FEBRUARY 28, 1874.

Dr.

Sewer pipes, rings, covers, &c.,	\$7,018 47
Manhole frames and covers,	3,367 30
Catch-basin covers,	904 46
Hinge traps,	658 13
Coping and gutter stones,	4,066 50
Bricks,	4,961 52
Iron rods,	17 66
Wedge bricks,	4,189 81
Iron sewer connections,	58 25
Invert blocks,	4,317 60
Stones from Dorrance street sewer,	516 94
Sheet piling,	306 60
Models, patterns, &c.,	130 86
Tools,	45 85
Sundries,	197 07
Dorrance street, from Westminster to Broad street, &c.,	10,373 16
Dorrance street, from Westminster street to the river,	13,084 52
Thomas Pearson, for Dorrance street, from Westminster street to the river,	16,790 85
Inspection of cement,	89 53
Inspection of connections,	263 83
City Treasurer,	175 31
W. A. Burdick, Agent,	702 00
Calvin C. Campbell,	586 53
Robert Blair,	313 00
Approved bills,	301,343 34
	<hr/> \$374,795 11

Cr.

Lobdell & Newman Brothers, for Weybosset and Westminster streets,	\$125 80
William Cochran, for Hospital, Langley and Eddy streets,	275 00
" " " Richmond and Clifford streets,	196 35
Cochran & Cassidy, for Olive and Prospect streets,	67 50
Thomas Newman, for Pearl street, from Broad to Mumford street,	1,591 61
Thomas Pearson, for intercepting sewer in Jackson and other streets,	2,859 45
Alfred Mundell, for Williams, Governor, Bower and Ives streets,	725 89
Alfred Mundell, for Benevolent and Governor streets,	178 75
H. B. Leach & Sons, for North Main street, from Olney street to foot of Constitution Hill,	210 00
Approved bills,	368,554 76
	<hr/> \$374,795 11

RECEIVED BY THE WATER COMMISSIONERS, SEWER DEPARTMENT, FROM
JANUARY 1, 1874, TO FEBRUARY, 28, 1874, INCLUSIVE, AND PAID TO
THE CITY TREASURER.

1874

January 17. Of Cochran & Cassidy, for labor and materials,	\$177 94
17. Of William Cochran, for labor and materials,	3 25
28. Of Cochran & Cassidy, labor,	1 25
	<hr/>
	\$181 84

1873-74.

MASS. STATE BOARD OF HEALTH, No. 83.
CITY DOCUMENT

ENGINEER'S OFFICE.

FIRST REPORT

OF THE BOARD OF

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE.

ON

SEWERS,

(Elected February 27, 1874.)

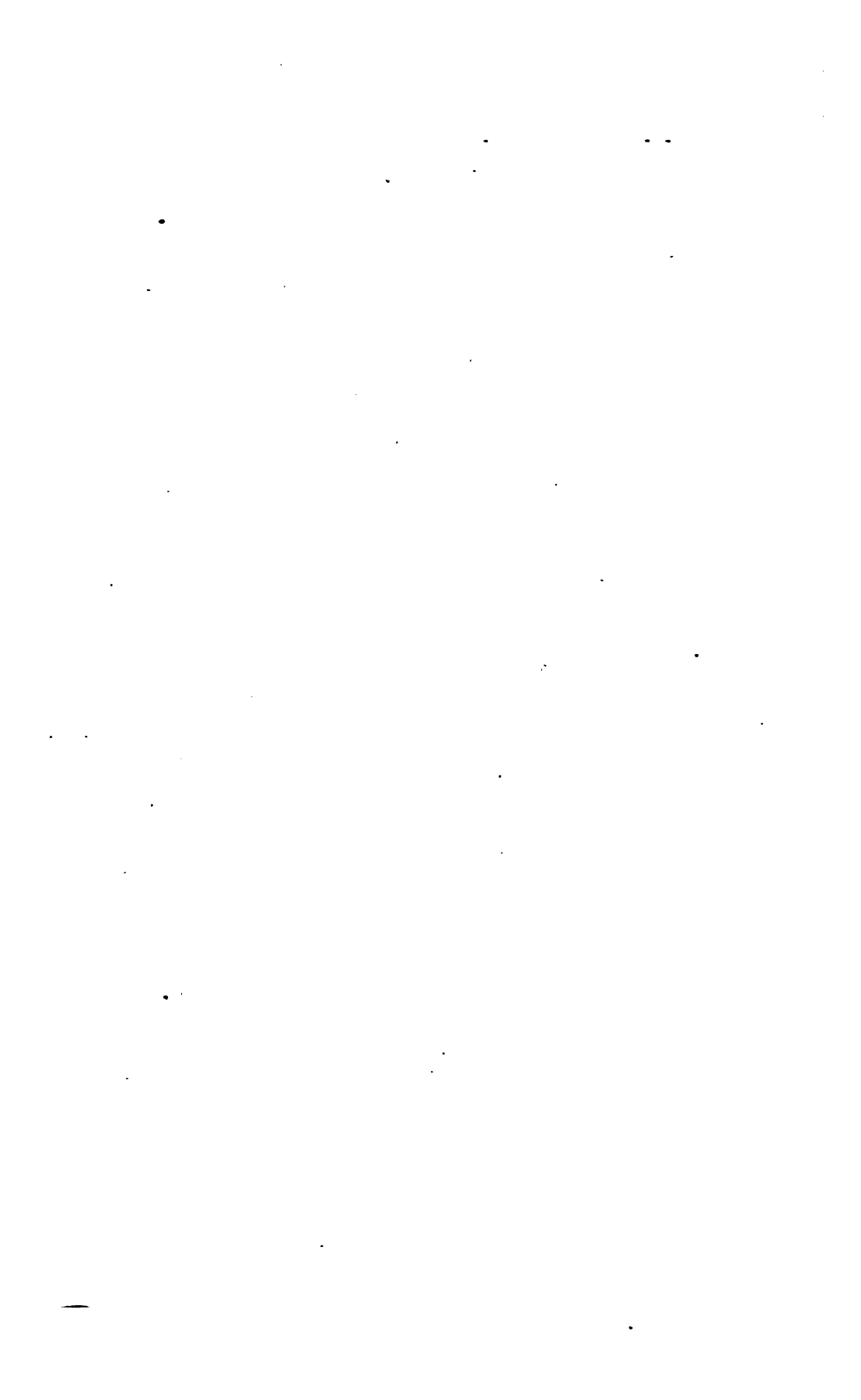
JUNE 1, 1874.



PROVIDENCE:

HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.

1874.



1873-74.

CITY DOCUMENT.

No 83.

FIRST REPORT
OF THE BOARD OF
WATER COMMISSIONERS
OF THE
CITY OF PROVIDENCE,
ON
SEWERS,

(Elected February 27, 1874.)

JUNE 1, 1874.



PROVIDENCE:
HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.
1874.

ORGANIZATION
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT.
CHARLES E. CARPENTER,
WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.
Office No. 35 North Main street.

CHIEF ENGINEER.

J. HERBERT SHEDD.
Office No. 35 North Main street.

REPORT.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
PROVIDENCE, June 1st, 1874.

TO THE HONORABLE THE CITY COUNCIL:

The Board of Water Commissioners, elected February 27, 1874, respectfully present their first report on Sewers.

The only sewer remaining to be reported upon to the Honorable Board of Aldermen by the Committee appointed by them to cause certain sewers to be constructed, under the provisions of Chapter 807, of the Public Laws, is that in *Dorance street from Westminster Street to the river.*

No settlement has been made with the contractor for building this sewer, as a suit for a considerable sum has been brought against the city for damage caused by his obstructing a lateral sewer.

The following sewers have been ordered by the City Council to be constructed since the date of the last report, made by the former Water Commissioners:

Aborn street, from near Sabin street, to Cove street, through West Exchange street.

Angell street and Wayland Avenue, from Gano street to Pitman street.

Arnold and Hope streets, from East street to Transit street.

Atwell's Avenue, from Dean street to Bourn street.

Bowen street, from Prospect street to Congdon street.

Broadway and Aborn street, from Bourn street to Washington street.

Brown and Charles Field streets, from George street to Brook street.

Carpenter street, from Ringgold street to Jackson street.

Charles Field and Benefit streets, from Brown street to Power street.

Claverick street, from Pine street to Broad street.

Clemence street, from Broad street to Westminster street.

College street, from Benefit street to the river.

Eddy street, from Lockwood street to Langley street.

Foster street, from Pine street to Broad street.

North Court street, from Benefit street to North Main street.

Pallas street, from Broadway to Vernon street.

Parsonage street, from Elm street to Point street.

Point street, from Parsonage street to Plane street.

Washington street, from its summit to Jackson street.

Williams street, from East street to near Hope street.

The City Council has also ordered Sand Catchers to be constructed in Fountain street.

Since the date of the last report, made by the former Water Commissioners, the accounts in relation to the following completed sewers have been made up. The cost of each is as follows:

Bassett street, from Elm street to Chestnut street; cost \$4,813.08.

Burr's Lane, from the head of the Lane to North Main street; cost, \$606.81.

Chestnut street, from Elm street to Point street; cost, \$2,812.21.

Clifford street, from Plane street to Chestnut street; cost, \$4,387.57.

Elm street, from Plane street to Chestnut street; cost, \$7,216.59.

George street, from Cooke street to Governor street, thence in Governor street to Benevolent street; cost, \$2,912.79.

High street, from Batley street to Westminster street; cost, \$12,645.30.

John street, from East street to Governor street; cost, \$1,146.75.

Meeting street, from Prospect street to Congdon street; cost, \$2,217.81.

Young Orchard Avenue, from Cooke street to Governor street; cost, \$1,037.94.

The following sewers have been completed since the date of the last report, made as aforesaid, but the accounts in relation to them are not yet in readiness for a statement of their cost.

Cooke street, from a point near Young Orchard Avenue to Power street, and through Power street to Ives street.

Power street, from Brown street to Benefit street.

Richmond street, from Broad street to Pine street.

Westminster street, from Jackson street to Dorrance street.

Westminster street, from Dorrance street to Exchange street.

Weybosset street, from the summit near the Arcade to Dorrance street.

The following sewers, ordered by the City Council, are in a state of progress, as follows :

Ives street, from Pitman street to Bower street ; 8 catch-basins with connections, remain to be built.

Thayer street, from Bowen street to Angell street, and through Angell and Brook streets to the river ; 320 feet constructed.

Broadway, from Almy street to Jackson street ; main line constructed from Jackson street to about half-way between Knight and Vinton streets.

Pitman street, from Ives street to Gano street ; 70 feet of pipe laid.

Broad street, from Stewart street to Chestnut street ; nearly completed.

Congdon street, from Bowen street to Angell street ; constructed from Angell street to about half-way between Meeting and Cushing streets.

Prospect street, from Jenckes to Meeting street, and through Meeting to Thayer street ; 460 feet of pipe laid.

Aborn and West Exchange streets ; 56 feet of brick and 96 feet of pipe sewer laid.

Eddy street, from Lockwood street to Langley street ; 185 feet of brick sewer laid.

Catch-basins in Fountain street ; of the 32 basins to be built 6 are completed and connected with sewer : 9 are completed but not connected.

Work on the following sewers (completing the list ordered to be constructed by the Water Commissioners,) has not been commenced :

Aborn street, from Washington street to Westminster street.

Benefit and Wickenden streets, from Williams street to Brooke street.

Power street, from Benefit street to South Main street.

Point street, from Parsonage street to Plane street.

Bowen street, from Prospect street to Jackson street.

Carpenter street, from Ringgold street to Congdon street.

Claverick street, from Pine street to Broad street.

Washington street, from its summit to Jackson street.

Clemence street, from Broad street to Westminster street.

Benefit and Charles Field streets, from Brown street to Power street.

North Court street, from Benefit street to North Main street.

Angell street and Wayland Avenue, from Gano street to Pitman street.

Arnold and Hope streets, from East street to Transit street.

Foster street, from Pine street to Broad street.

Pallas street, from Vernon street to Broadway.

Parsonage street, from Elm street to Point street.

Williams street, from East street to near Hope street.

College street, from Benefit street to the River.

Atwell's Avenue, from Dean street to Bourn street.

Broadway and Aborn street, from Bourn street to Washington street.

Brown and Charles Field streets, from George street to Brook street.

Assessments for the following sewers have been completed and certified to the City Treasurer :

<i>Arlington Avenue, Angell, Gano and Pitman sts.,</i>	<i>\$12,752 46</i>
<i>North Main street,</i>	<i>7,356 10</i>
<i>Manchester, Point and Eddy streets,</i>	<i>4,816 41</i>
<i>Watermun street, from Cooke street to Gano street,</i>	<i>4,108 06</i>
<i>Fountain street, from Aborn street to Cove street,</i>	<i>2,374 93</i>

REPORT ON SEWERS.

9

<i>Meeting street, from Congdon street to North Main st.,</i>	1,857	22
<i>Angell and Waterman streets,</i>	-	3,371 05
<i>Bowen street, from Prospect street to Thayer street,</i>	4,135	21
<i>Washington street, from Jackson street to Dorrance st.,</i>	4,863	96
<i>Waterman street, from Prospect street to Benefit street,</i>	1,981	49
<i>Point street, from Parsonage street to Eddy street,</i>	2,126	76
<i>Eddy street, from Elm street to Point street,</i>	-	1,414 63
<i>Camp street, from Olney street to Lippitt street,</i>	1,699	08
<hr/>		
Total,	-	\$52,857 36

Drain-Layers' licenses have been issued during the last quarter, as follows :

James Cassidy,	Asa K. Lilley,
William Cochran,	Henry F. Mason,
Nathan B. Horton,	James C. Peck.

The total number of such licenses issued to date is thirty.

A schedule of sewer bills, approved by the Board of Water Commissioners, from March 1, 1874, to May 30, 1874, inclusive; a trial balance of the Board of Water Commissioners' Ledger, Sewer Department, May 30, 1874, inclusive; a trial balance of the Ledger of the Committees appointed by the Board of Aldermen to build certain sewers, May 30, 1874, inclusive; and a schedule of receipts by the Board of Water Commissioners, Sewer Department, and paid to the City Treasurer from March 1, 1874, to May 30, 1874, inclusive, are hereunto appended and made parts of this report.

JOSEPH J. COOKE,	} <i>Board of Water Commissioners.</i>
CHAS. E. CARPENTER,	
WILLIAM CORLISS.	

SCHEDULE OF BILLS APPROVED BY THE BOARD OF WATER
COMMISSIONERS, SEWER DEPARTMENT, FROM MARCH 1, 1874,
TO MAY 30, 1874, INCLUSIVE.

337	Charles H. Pierce, paid by him for labor on sewers,	-	\$366 17
338	" " " " " " sundries, -	-	29 00
339	Thomas Phillips & Co., sewer scoops, chafing blocks, labor, &c.,	-	77 08
340	Dexter Gorton & Co., lumber, labor, &c., -	-	9 18
341	George W. Hall & Co., cement and sewer pipe, -	-	37 34
342	Rhode Island Concrete Co., concreting around catch-basins,	-	3 50
343	William H. Miller & Co., tools and repairing same, -	-	4 71
344	William S. Briggs, horse-hire by engineers, -	-	3 00
345	Russell & Richardson, drawing and engraving diagrams, " rain fall " &c., -	-	19 50
346	Allen Fire Department Supply Co., brass castings, labor, &c.,	-	12 22
347	Taft & Beedle, catch basin stones, -	-	30 00
348	Hopkins & Pomroy, cement, stone, &c., -	-	88 28
349	Providence Water Works, labor on brick arches, catch-basin stones, &c., -	-	53 25
350	Narragansett Brick Co., bricks, -	-	130 75
351	A. C. Eddy & Studleys, repairing rubber boots, -	-	6 00
352	Barker, Whitaker & Co., tools, &c., -	-	11 66
353	James Moran, kerosene oil and wicks, -	-	1 86
354	Allen Aldrich, salary as superintendent of cleaning and re- pairs, -	-	85 00
355	Henry L. Ripley, salary as engineer, private drains, -	-	100 00
356	William Whittaker, salary as inspector, sewer in Ives street,	-	35 71
357	Thomas R. Belcher, " " " on sewers, &c., -	-	78 57
358	Statement of materials, &c., transferred from Ledger of the Committees, appointed by the Board of Aldermen to con- struct certain sewers, -	-	37,312 21
359	Providence Water Works, wharfage, cartage and labor, -	-	752 67
360	H. B. Leach & Sons, contract reservation, sewer in Young Orchard Avenue, -	-	23 50
361	Fuller Iron Works, branding irons, -	-	7 50
362	Hopkins & Pomroy, cement, -	-	8 00
363	Stanton Clark, Agent, catch-basin stones, -	-	130 00
364	Stephen Knobb, hauling catch-basin stones, -	-	17 39
365	G. B. & W. F. Inman, " " " -	-	47 00
366	Taft & Beedle, catch-basin stones, -	-	31 00
367	Grant Brothers, repairing tools, -	-	2 50
368	A. C. Eddy & Studleys, hip boots, -	-	5 00
369	Charles H. Pierce, paid by him for labor on sewers, -	-	218 88
370	William Whittaker, salary as inspector on sewers, -	-	32 25
Amount carried forward, -			\$39,770. 68

REPORT ON SEWERS.

11

	Amount brought forward,	-	-	-	\$39,770 68
371	Thomas R. Belcher, salary as inspector on sewers,	-	-	-	67 74
372	Charles H. Pierce, paying laborers, &c.,	-	-	-	467 33
373	Daniel Carlin, kerosene oil,	-	-	-	3 88
374	James R. Osgood & Co., illustrations for sewer report, 15 plates,	-	-	-	325 00
375	Providence Water Works, labor on brick arches,	-	-	-	20 00
376	George W. Hall & Co., bricks and cement,	-	-	-	1,730 88
377	William Nelson Jr., sewer pipe,	-	-	-	204 00
378	Providence & New York Steamship Co., freight of sewer pipe,	-	-	-	31 25
379	W. A. Burdick, Agent, catch-basin stones,	-	-	-	1,394 00
380	G. B. & W. F. Inman, hauling catch-basin stones,	-	-	-	40 00
381	Alfred Mundell, pump,	-	-	-	10 00
382	A. C. Eddy & Studleys, rubber boots, &c.,	-	-	-	17 75
383	Mason, Chapin & Co., marking pots, brushes, oil, &c.,	-	-	-	2 56
384	Dexter Gorton & Co., lumber, labor, &c.,	-	-	-	9 58
385	Stanton Clark, Agent, catch-basin stones,	-	-	-	187 00
386	Hopkins & Pomroy, cement and carting bricks,	-	-	-	11 45
387	Charles H. Pierce, paid by him for sundries,	-	-	-	88 91
388	M. D. Copeland, teaming,	-	-	-	3 88
389	Calvin C. Campbell, catch-basin stones,	-	-	-	792 00
390	Allen Aldrich, salary as superintendent of cleaning and repairs,	-	-	-	85 00
391	Henry L. Ripley, salary as engineer, private drains,	-	-	-	100 00
392	William Corliss, travelling expenses of self and part of expenses of J. Herbert Shedd to New York and Philadelphia,	-	-	-	72 00
393	J. W. & J. J. Newman, construction of sewer in Weybosset street, from near the Arcade to Dorrance street,	-	-	-	606 10
394	Providence Water Works, wharfage, cartage and labor,	-	-	-	21 14
395	" " " services of engineers,	-	-	-	2,775 24
396	George Fox, repairing manholes,	-	-	-	18 00
397	George W. Hall & Co., bricks,	-	-	-	1,766 05
398	Robert Blair, " "	-	-	-	468 00
399	J. W. & J. J. Newman, construction of sewer in Richmond street,	-	-	-	455 76
400	Charles H. Pierce, paid by him for sundries,	-	-	-	12 03
401	William Nelson, Jr., sewer pipe,	-	-	-	283 69
402	Providence and New York Steamship Co., freight of sewer pipe,	-	-	-	228 56
403	Charles H. Pierce, paying laborers, &c.,	-	-	-	2,650 11
404	Sloop General Warren, freight of sewer pipe,	-	-	-	136 00
405	Westerly Granite Works, on account for catch-basin stones delivered,	-	-	-	700 00
406	Gillmore & Judge, on account for constructing sewer in Broad street,	-	-	-	1,775 00
407	H. B. Leach & Sons, on account for constructing sewer in Prospect and Meeting streets,	-	-	-	140 00
	Amount carried forward,	-	-	-	\$57,371 57

	Amount brought forward, - - -	\$57,371 57
408	Alfred Mundell, on account for constructing sewer in Broadway, - - -	2,450 00
409	Henry L. Ripley, salary as engineer, private drains, - - -	100 00
410	Allen Aldrich, " " superintendent of cleaning and repairs, - - -	85 00
411	Edward Burr & Co., repairing hose, - - -	8 00
412	William S. Briggs, horse hire by engineers, - - -	72 00
413	J. W. & J. J. Newman, on account for constructing sewer in Congdon street from Bowen to Angell street, - - -	1,250 00
414	H. B. Leach & Sons, on account for constructing sewer in Thayer, Angell and Brook streets, - - -	975 00
415	Albert E. Fuller, salary as inspector on sewers, - - -	11 25
416	James W. Murray, " " " " " " - - -	64 00
417	William Whittaker, " " " " of catch-basin stones, - - -	10 00
418	Thomas F. Crandall, " " " " on sewers, - - -	88 00
419	William H. Smith, " " " " " " - - -	56 00
420	Duty J. Greene, " " " " " " - - -	58 00
421	Thomas R. Belcher, examining intercepting sewer in Jackson and other streets, - - -	3 33
422	G. B. & W. F. Inman, hauling catch-basin stones, - - -	111 00
423	Wheeler M. Blanding, sand, - - -	18 00
424	Charles H. Pierce, paid by him for sundries, - - -	9 78
425	Thomas R. Belcher, salary as inspector on sewers, &c., - - -	60 00
426	George S. Dow, canvass, - - -	23 50
427	Providence and New York Steamship Co., freight of sewer pipe, - - -	47 19
428	William Nelson, Jr., sewer pipe, - - -	3,864 53
429	Albert Dailey & Co., lumber, - - -	91 81
430	Stanton Clark, Agent, catch-basin stones, - - -	374 00
431	Charles H. Pierce, paying laborers, &c., - - -	3,954 17
432	W. A. Burdick, Agent, catch-basin stones, - - -	1,040 00
433	M. D. Copeland, teaming, - - -	117 73
434	Henry Blundell, Agent, labor, &c., sewer in Westminster street from Jackson to Dorrance street, - - -	238 53
435	Hopkins & Pomroy, cement, carting bricks, &c., - - -	803 65
436	Providence and New York Steamship Co., freight of sewer pipe, - - -	61 36
437	Alfred Mundell, labor, &c., sewer in Broadway, - - -	39 51
438	Wm. D. Andrews & Bro., bottom for drainage pump, - - -	41 00
439	Joseph B. Anthony, double blocks, - - -	13 20
440	George Campbell, gravel screen, repairing hose, &c., - - -	19 00
441	A. Meisel, engraving and printing maps, for Report on sewerage in Providence. - - -	382 25
442	John Doyle, culling bricks, - - -	126 00
443	W. S. Fifield, canal wheel-barrows, - - -	12 50
444	Alfred Mundell, use of steam pump, - - -	150 00
445	Westerly Granite Works, catch-basin stones, - - -	395 00
446	Sloop Fred Brown, freight of sewer pipe, - - -	46 12
	Amount carried forward. - - -	\$74,641 98

REPORT ON SEWERS

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Amount brought forward,	-	-	-	-	\$74,641 98
447 Narragansett Brick Co., bricks,	-	-	-	-	323 40
448 Charles F. Pope, powder, fuse, &c.,	-	-	-	-	4 28
449 John Condon, culling bricks,	-	-	-	-	18 00
450 John Doyle, " "	-	-	-	-	120 00
451 Congdon, Carpenter & Co., iron rods,	-	-	-	-	31 52
452 Charles H. Pierce, paying laborers, &c.,	-	-	-	-	4,997 83
453 G. W. Rader & Co., invert blocks, &c.,	-	-	-	-	303 10
454 Delaney & Walsh, repairing tools,	-	-	-	-	7 30
455 Allen Fire Department Supply Co., couplings, labor, &c.,	-	-	-	-	18 53
456 Charles H. Pierce, paid by him for sundries,	-	-	-	-	10 29
457 Albert Dailey & Co., lumber,	-	-	-	-	91 81
458 George W. Hall & Co., cement and pipe,	-	-	-	-	110 90
459 Henry T. Root, galvanized pump and repairing tools,	-	-	-	-	37 87
460 A. C. Eddy & Studleys, rubber boots, coats, &c.,	-	-	-	-	51 38
461 G. & C. P. Hutchins, lanterns, oil, globes, &c ,	-	-	-	-	48 24
462 Schooner J. M. Freeman, freight of sewer pipe, (charged to G. W. Rader & Co.,)	-	-	-	-	90 00
					<hr/>
					\$80,906 43

TRIAL BALANCE OF BOARD OF WATER COMMISSIONERS' LEDGER, SEWER
DEPARTMENT, MAY 30, 1874.

Dr.

Books, stationery, etc.,	\$39 50
Traveling expenses of Commissioners,	51 62
Stones from Dorrance street sewer,	516 94
" " Westminster street sewer,	793 85
Iron rods,	49 18
Iron sewer connections,	58 25
Invert blocks,	4,592 60
Wedge bricks,	4,070 13
Catch basin covers,	593 77
Catch basin traps,	608 13
Manhole frames and covers,	2,370 44
Catch basin stones,	13,864 62
Sewer pipes, rings, covers, etc.,	10,275 35
Bricks,	7,683 36
Sheet piling,	860 51
Shed for storing materials,	124 31
Superintendence of cleaning and repairs,	761 17
Cleaning and repairing old sewers,	2,997 09
Repairing new sewers,	259 77
Cleaning catch basins and sewers,	3,518 71
Inspection of connections,	1,871 19
Inspection of catch basin stones,	431 55
Testing cement,	864 15
Sundries,	149 77
Printing,	822 84
Centres, forms, templets, etc.,	197 51
Tools,	3,914 52
City Treasurer,	590 47
Sewer in Young Orchard avenue, from Cooke to Governor street,	1,037 94
" " Meeting street from Prospect to Congdon street,	2,217 81
" " Clifford street from Plane to Chestnut street,	4,387 57
" " Elm street from Plane to Chestnut street,	7,216 59
" " John street from East to Governor street,	1,146 75
" " Bassett street from Chestnut to Elm street,	4,813 08
" " George and Governor streets,	2,912 79
" " Burr's lane,	606 81
" " Chestnut street from Elm to Point street,	2,812 21
" " Cooke and Power streets,	3,985 76
" " High street from Battey to Westminster street,	12,645 30
" " Power street from Brown to Benefit street,	886 09
" " Ives street from Pitman to Bower street,	13,385 56
" " Weybosset street from near the Arcade to Dorrance street,	664 33
" " Thayer, Angell and Brook streets,	212 99
" " Westminster street from Jackson to Dorrance street,	10,861 58
" " Richmond street from Broad to Pine street,	536 64
" " Broad street from Stewart to Chestnut street,	149 05
" " Prospect and Meeting streets,	38 67
" " Broadway from Almy to Jackson street,	200 61
" " Congdon street from Bowen to Angell street,	80 07
" " Westminster street from Dorrance to Exchange street,	84 59
Amount carried forward,	\$133,779 09

REPORT ON SEWERS.

15

Amount brought forward,	\$133,779 00
Sewer in Aborn street from Sabln to Cove street,	34 73
Catch basins in Fountain street,	25 73
Additional catch basins,	166 34
Additional work on sewers,	310 45
H. B. Leach & Sons, for Thayer, Angell and Brook streets,	975 00
" " " " Prospect and Meeting streets,	140 00
Gillmore & Judge for Broad street from Stewart to Chestnut street,	1,775 00
Alfred Mundell, for Broadway from Almy to Jackson street,	2,450 00
J. W. & J. J. Newman, for Congdon street from Bowen to Angell street,	1,250 00
G. W. Rader & Co.,	90 00
Providence Gas Company,	10 00
Engineering department for horse hire,	377 00
" " " books, stationery, etc.,	14 70
" " " sundries,	193 44
" " " printing,	55 62
" " " advertising,	32 37
" " " labor,	136 57
" " " instruments,	7 19
" " " brick arch experiments,	72 95
	<hr/> \$141,806 18

CN.

Francis McGrath for Clifford street from Plane to Chestnut street,	90 11
" " " Elm street from Plane to Chestnut street,	160 87
H. B. Leach & Sons, for George and Governor streets,	97 50
" " " Cooke and Power streets,	180 35
Alfred Mundell, for High street from Battey to Westminster street,	367 71
J. W. & J. J. Newman, for Weybosset street from near the Arcade to Dorrance street,	30 00
J. W. & J. J. Newman, for Richmond street from Broad to Pine street,	25 00
Calvin C. Campbell,	198 00
Approved bills,	\$140,746 64
	<hr/> \$141,806 18

TRIAL BALANCE OF LEDGER, COMMITTEES APPOINTED BY THE BOARD OF
ALDERMEN TO CONSTRUCT CERTAIN SEWERS, MAY 30, 1874.

DR.

Dorrance street from Westminster to Broad street, etc.,	\$10,372 16
Dorrance street from Westminster street to the river,	13,169 23
Thomas Pearson, for Dorrance street from Westminster street to the river,	16,897 90
Approved bills,	338,654 55
	<hr/> \$378,993 84

CR.

Thomas Newman, for Pearl street from Broad to Mumford street,	1,590 36
Thomas Pearson, for intercepting sewer in Jackson and other streets,	2,732 89
Alfred Mundell, for Williams, Governor, Bower and Ives streets,	735 89
Alfred Mundell, for Benevolent and Governor streets,	178 75
Calvin C. Campbell,	1,017 50
Approved bills,	372,788 45
	<hr/> \$378,998 84

RECEIVED BY THE BOARD OF WATER COMMISSIONERS, SEWER DEPART-
MENT, FROM MARCH 1, 1874, to MAY 30, 1874, INCLUSIVE, AND PAID TO
THE CITY TREASURER.

1874.

March 9. Of Calvin C. Campbell, for labor,	\$7 69
April 17. Of H. A. Carson, for stones,	1 50
24. Of Thomas Pearson, for labor and materials,	8 00
30. Of H. A. Carson, for stones,	75
May 14. William Cochran, for labor and materials,	9 00
	<hr/> \$36 94

Providence, R. I. - Special Committee on the
works and sewers

627209 P

1873-74.]

CITY DOCUMENT.

118
[No. 116.]

REPORT.

ON THE

WATER WORKS AND SEWERS,

IN THE

CITY OF PROVIDENCE,

PRESENTED TO THE BOARD OF ALDERMEN, NOVEMBER 2, 1874.



PROVIDENCE:

HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.

1874.

Providence, R.I. - *Special committee on*
water works and sewers

1873-74.]

CITY DOCUMENT.

[No. 118.]

REPORT.

ON THE

WATER WORKS AND SEWERS.

IN THE

CITY OF PROVIDENCE,

PRESENTED TO THE BOARD OF ALDERMEN, NOVEMBER 2, 1874



PROVIDENCE:

HAMMOND, ANGELL & CO., PRINTERS TO THE CITY.

1874.

**RESOLUTION OF THE BOARD OF ALDERMEN, appointing a Special Committee
of Inquiry, in relation to WATER WORKS AND SEWERS.**

REPORT OF THE SPECIAL COMMITTEE of the Board of Aldermen.

REPORT OF THE BOARD OF WATER COMMISSIONERS.

RESOLUTION OF THE BOARD OF ALDERMEN.

[Passed October 12, 1874]

RESOLVED, That Aldermen Fisher, Spicer and Clarke, be and they are hereby appointed a committee to inquire into and report to this board, as soon as practicable, upon the following matters, connected with the introduction of water into this city, and the construction of sewers, to wit:

The actual cost of the water works, and their capacity at date of last quarterly report, as compared with the original estimates and plans,—meaning that the whole amount of expenditures, according to said quarterly report, shall be so classified as to give the exact cost of each division of the works, including in such classification the cost of lands and water privileges, and separating maintenance from construction: the original estimates for the work to be classified in the same manner, so that a comparison may be made between them.

The revenue, thus far, from water, as compared with the revenue from same number of miles of pipe in other cities and at the same stage of construction.

The probable length of time that will elapse before it will be necessary to erect a second engine at Pettaconset pumping station.

The cost of the stand pipe to be erected at the Pettaconset engine-house in connection with the Cornish engine now under contract; and whether it will also serve for any additional engines that may be erected there.

" The cost of the stand pipe at the Hope engine-house, if one has been erected there, or, if not, whether one will be required for the second engine recently contracted for, and if so, its probable cost.

" What amount has been paid for marble used in construction, and where located, and what sums have been expended for foreign granite, and where it was obtained.

" The number of the employés in the engineering department, and the capacities in which they severally act, with the rate of yearly compensation of each.

" The accessibility of all contracts and records in the office of the board of water commissioners, to any citizen who may desire to examine them.

" The comparative merits and cost of Scotch and other pipes, and the proportion of our sewers constructed of pipes of Scotch manufacture.

" The depths and sizes of our sewers, as compared with those of the larger cities of this country.

" The depths of our sewer outlets, with reference to the tides ; and the cases of damage, if any, resulting from the overflow of tide water from the sewers into the basements of buildings ; and, if any, the cause of such damage and the proper remedy therefor.

" The amount of deposit in the sewers since their acceptance by the city, stating particularly the amount in that portion of the sewers flowed by tide water.

" The method employed for cleaning the sewers, and to what extent such cleaning is necessary.

" The condition and capacity of the stone sewers taken up, their total length, with the sizes and kinds of sewers substituted therefor.

" Whether any sewers have been constructed which were not ordered by the city council, and if so, where located, and the reasons for such construction.

" The kind of pipe which parties connecting with sewers are required to use.

*REPORT OF THE COMMITTEE OF THE BOARD
OF ALDERMEN.*

[Presented November 2, 1874.]

TO THE HONORABLE, THE BOARD OF ALDERMEN OF THE
CITY OF PROVIDENCE:

The committee appointed October 12th, 1874, to report to this board upon various matters connected with the introduction of water into this city and the construction of sewers, respectfully beg leave to present this their report:

The inquiries under the resolution were so many and included, as they did, those most important, bearing upon both the introduction of water and the construction of sewers, that the committee almost shrank from the duty imposed upon them. But they felt that matters of great importance were involved, concerning which the tax payers and citizens generally had a right to be informed.

It is obvious that for the information sought in the resolution, the committee must depend in a great measure upon the records in the office of the water commissioners, and from the water commissioners and chief engineer themselves. The committee waited upon the water commissioners, and were courteously received, and at three long interviews at their office, every facility was afforded to throw light upon every inquiry in the resolution. The committee were allowed free and full access to all the books of account and records in that office, and were aided by Mr. C. D. Sellew, the secretary, in the examination.

At the first meeting of the committee with the water commissioners and chief engineer, the resolution under

which the committee were acting, was presented to them, and after a very free, full and lengthy interview as to what the resolution comprehended, the committee requested them to submit a report in writing, at their earliest convenience, touching all the matters of which we desired information. With creditable promptness, they submitted to the committee their answers to all the inquiries. We submit herewith their answers as received by the committee, which are full and complete. Most of these answers may receive confirmation from their quarterly reports, submitted to the city council at various times.

As to the practicability of some things connected with the construction of both the water works and sewers, there may be a difference of opinion among practical minds. The facts the committee have obtained can be fully substantiated by the records in the office of the commissioners, and the works, both water and sewer, as they stand partially constructed to-day.

The committee do not wish to lengthen out their report by a repetition of what is in the report of the water commissioners to the committee. But they earnestly ask the board to read and examine carefully all the facts and figures in the report of the commissioners, in order that they may be able to form an intelligent opinion concerning matters bearing upon the construction of the most important works in which this city ever has been or ever will be engaged. It may be well for the committee to notice some of the important items contained in the commissioners' communication. It will be seen that the original estimate of the cost of the water works was four millions four hundred and seventy-seven thousand thirty-five dollars and eight cents (\$4,477,035 08), and that the original plan has been very much changed, materially enlarged and improved. It is expected that it will be completed by the next summer, so far as to pass from the hands of the water commissioners to the city.

The whole cost of construction to September 1st, 1874, was three millions four hundred fifty-seven thousand four hundred forty-four dollars and seventy-nine cents (\$3,457,444 79), or one

million nineteen thousand five hundred and ninety dollars and twenty-nine cents (\$1,019,590 29) less than the original estimate. This, as will be seen, is after deducting the cost of maintenance from Jan. 1, 1872, to September 1, 1874, which was eighty-one thousand six hundred fifty dollars and seventy-four cents (\$81,650 74).

It will be noticed that the water works were commenced May 4, 1870, and that water was introduced December 1, 1871—one year and seven months. From the latter date a revenue commenced to the city at a time when only one million four hundred and ninety-four thousand three hundred thirteen dollars and ten cents, (\$1,494,313 10) had been expended. The revenue the first year was \$41,008 51, or about two and three quarters per cent. on the cost to that time. The second year, the income was \$97,386 09. The third year, estimating the last four months at the ratio of the first eight months, it was \$145,551 68, or total to Dec. 1, 1874, \$283,941 28, or eight and one-fifth per cent. on the cost to Sept. 1, 1874.

These figures, we think, will be satisfactory to the citizens of Providence, and are certainly creditable to the water commissioners and their chief engineer, as showing the perfection of the work when only partially constructed, and their entire willingness that the water should be let on, that the city might earlier derive an income therefrom. It is unusual and almost entirely without precedent, that works of this kind are opened to public use until completed. This certainly showed a confidence in their work, as far as it had gone, and experience has since proved the correctness of that confidence.

The committee have nothing but commendation to offer in regard to the manner in which a large portion of the work of introducing water into the city has been done. The great care which has been taken in regard to the manufacture of the iron pipe, so that it should be of uniform quality, thickness and durability, has doubtless rendered this portion of the work superior to that of any other city in the United States. And when it is remembered that the cost of the iron pipes in which

the water is brought from the reservoir and conducted through the streets, including the cost of laying them, constitutes fully one-half of the whole expense of the water works; and when we reflect that these pipes are all laid several feet underground, and therefore difficult of access and expensive to repair, it will at once be conceded that too much care could hardly be given to their proper manufacture, and that no expense was unnecessary which would insure a perfect and durable pipe.

In the building of the reservoirs, also, so far as your committee are able to judge, the work seems to have been substantially and thoroughly done, and there can scarcely be a question as to their durability.

The water-works for the supply of any city where the necessity exists of raising water to a certain height and storing it for distribution, may be divided into three general divisions. First, the reservoirs into which the water is to be raised and stored. Second, the system of pipes or conduits through which the water is to be distributed for use; and, third, the pumping apparatus for forcing the water to the required height. The first and second of these general divisions are necessarily required to be, and it is doubtless the best economy that they should be, of as permanent and durable a character as the experience and science of the present day can devise and build. In these two divisions, as has already been stated, your committee take great pleasure in commending the work done as alike creditable to the city and honorable to the commissioners and engineer who have planned and executed it. In regard to the third division, namely, the pumping system for raising and forcing the water from the river into the reservoir, your committee gladly and willingly concede that the water commissioners and the chief engineer, in providing the very costly apparatus which is now in process of erection at the pumping station at Pettaconset, have acted with the same regard as to what they believe to be for the best interests of the city, as in those portions of the work already spoken of; yet your committee feel obliged to differ radically with the

commissioners as to the necessity of so large an outlay. The cost of the Pettaconset pumping station, now in process of erection for the Cornish engine, including pump, well, foundations, and all essential requirements for the same, to September 1st last, as furnished us by the commissioners, was two hundred and seventeen thousand seven hundred and forty-five dollars, sixty-two cents (\$217,745.62); their estimated amount to complete same, seventy-seven thousand four hundred and fifty dollars (\$77,450); Cornish engine, delivered and set up, per contract, one hundred and six thousand dollars (\$106,000); tools and extra prices for same, \$14,000; rough pieces for same, to be furnished for same by commissioners, seven thousand six hundred and thirty-seven dollars and forty cents (\$7,637.40); stand-pipe, per contract, to be set up by contractor, twelve thousand dollars (\$12,000); amount expended on natural filter basin, \$33,594.50; thus making the total cost of the pumping apparatus connected with and including the Cornish engine, \$468,427.52.

This sum is the amount actually paid or to be paid for this purpose, without reckoning anything which would be properly chargeable to this department of the works for its proportion of salaries, engineering and miscellaneous expenses. If this were added, it would make the cost of the pumping department of the water works in round numbers, very nearly a half million of dollars. This plan also requires for its completion an additional Cornish engine, which would add at least one hundred thousand dollars more to the cost of this department of the service. The Worthington engine, now in operation at Pettaconset, cost, including all repairs up to September 1st, 1874, \$41,452.38. The building in which it is placed, cost \$9,718.09. This engine takes the water directly from the river, and has for three years past, supplied the city with all the water it has used. It has not run, on an average, six full days in a week, and that the supply of water has been abundant, is a fact patent to every citizen. If this engine should be run day and night it would furnish about

double the quantity of water which is now daily used for all purposes, including, of course, the fire supply.

It would not, however, answer to depend upon one engine for continual service, as there must occasionally be stoppages for repairs, and breakages are liable to occur. If another Worthington engine of the same cost and capacity as the one now in use, were placed at the pumping station, the city would have, without any doubt whatever, sufficient pumping power to supply itself abundantly with all the water needed for ten or fifteen years to come. The simple interest upon the money which has been and will be expended upon the completion of the pumping station at Pettaconset, including engines, stand-pipe, chimney, and all appurtenances belonging to this department of the service, would suffice to build a new Worthington engine, of same capacity as the one now in use, once in every two years. The city would also have the advantage, by taking the course above indicated, of being in a position to avail itself at any time during the coming ten or fifteen years, and at a little comparative loss and without the slightest danger to the water service, of any improvement in pumping engines which the inventive genius of the country might produce. Whereas, the course taken by the water commissioners in this matter, precludes the city almost entirely, unless at an immense loss, from making any change or adopting any improvement in the very department of the water works where improvement may be most desirable, and is most likely to occur. For these and other reasons which will readily suggest themselves, your committee cannot agree with the water commissioners in their view of the necessity of spending so large an amount in the pumping department at Pettaconset.

We ask your particular attention as to what the commissioners say in regard to the comparative merit and cost of Scotch and other pipes. We think their testimony and that of others, from which they quote at some length, establishes the wisdom of putting the best pipe into our deep sewers, inasmuch as the difference in the first cost of the pipe is small compared with the whole cost of the sewers or that of taking

up the sewers or any portion of them, in consequence of imperfect pipe, and from disintegration from any cause, after being laid.

The committee are of the opinion that to put other pipe than that known to be durable for a long period, into sewers, would be a mistaken policy, as it would be more costly in the end, besides the great inconvenience it would cause those who use the sewers, should they give out.

The committee saw various kinds of pipe subjected to a strong test by being immersed in acid. Some would stand the test perfectly, and others would commence dissolving at once. Where only fresh water is to pass, the kind of pipe is not of so much consequence. But inasmuch as no rule or ordinance can prevent any and all substances, at times, being introduced into our sewers, it would be bad economy to put in any pipe which would not be impervious to any substances which might go into them from our chemical works, print works and other manufactories.

The committee had before them Mr. Tripp, a manufacturer of drain pipe, etc., in this city. He was given a patient hearing, and produced letters and reports from various parties and cities who are using cement pipe with satisfactory results, and still continue its use. The committee do not doubt that, for most purposes, where only ordinary substances are to enter, that it will answer well, and should recommend it for private and public use in such cases. But to introduce it into our deep sewers, the committee would consider it inexpedient and unwise. You will bear in mind that as no chain is stronger than its weakest link, so no sewer is secure with any portion being laid with imperfect or doubtful pipe.

As to the depths and sizes of our sewers, the committee, in addition to the written report of the water commissioners to them concerning these points, heard the commissioners and chief engineer fully in regard to all matters bearing upon them. And we are of the opinion, that in the main, the plans they have pursued in laying them, are correct, and for the present and future interests of our growing city. We recom

mend to the board particularly, that portion of their report touching these matters and all others connected with the subject of sewers, as being full and intelligent, together with facts concerning sewers in other cities.

The commissioners personally showed every desire to convey to the committee a full understanding of what they are, and have been doing. We were more than pleased by the apparent perfect system by which their accounts and records are kept, and by their arrangements for careful inspection of all material used in the construction of the water works and sewers, and the great care they were taking to check everything from entering in at variance with the city's real interest, and the perfecting of the great work in which they are acting as the city's agents.

In great public works of this kind, it is true economy to arrive as near perfection in their construction as possible. These works are intended to last for all time, resulting in untold blessings to the latest posterity and promoting the growth and prosperity of our city. When they shall be completed, we shall not be ashamed to compare them with those of any other American city.

It is not sufficient that our water works should be constructed only to supply a city twice or thrice the size of ours at present. Inasmuch as we anticipate a great future, we should plan in the beginning for such, in the quantity of water as well as reservoirs, engines, engine-houses and main pipes, so as to answer for this growth. There are some things connected with the construction for which we can wait until the growth of the city demands it.

But these main things ought to be provided at the outset. We believe it is the desire, above all others, of the water commissioners to pass over to this city, so far as they go, a complete and thorough work. They believe this to be for the best interests of the city and true economy, and to this end they are diligently and faithfully working. The particular examination of every material entering into the construction of the water works and sewers, requires, of course, intelligent

service and increase of help, which adds to the cost. But it is all saved and more, to the city, by the rejection of imperfect material. Nothing is intended to go into the works, that has not passed the ordeal of a thorough inspection. The committee are not inclined to lengthen their report, inasmuch as the answers of the water commissioners are so full and complete. Perhaps they need not say more, but could not say less. In closing, we ask the board and the public generally to examine carefully the facts brought to light by this resolution. It would be wonderful if some errors have not been committed in so large an undertaking. If there have been, and they can now be remedied, let them be stayed; but before condemnation, let all be carefully considered and examined, in order that we may form an enlightened judgment. To aid such judgment has been the only object of this examination and this report, which we now most respectfully submit.

ADDISON Q. FISHER,
GEORGE T. SPICER, } Committee.
GEO. L. CLARKE,

COMMUNICATION FROM THE BOARD OF WATER COMMISSIONERS.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
PROVIDENCE, R. I., October 30, 1874. }

MESSRS. ADDISON Q. FISHER, GEORGE T. SPICER, GEORGE L. CLARKE, COMMITTEE OF THE BOARD OF ALDERMEN:

Gentlemen: In answer to your request for information in regard to the matters mentioned in a resolution of the Board of Aldermen, passed October 12th instant, in relation to water works and sewers, the Water Commissioners respectfully report:

First: As to "*the actual cost of the water works and their capacity, at date of last quarterly report,*" etc.:

The original estimate of the cost of the introduction of water by the Pawtuxet plan (one of four reported to the City Council in October, 1868, by the Joint Special Committee of that body) was..... \$4,477,035 08

The actual cost of land and land and water damages, construction and maintenance, to September 1, 1874, as shown by the Commissioners' Trial Balance of Ledger (City Document No. 103, current series, page 29), was:

Amount of approved bills.....	\$3,696,126 47
Amount to the credit of J. B. & J. M. Cornell.....	1,000 00
Amount to the credit of Warren Foundry and Machine Co.,....	4,195 00
Amount to the credit of Gloucester Iron Works....	7,490 47
Amount to the credit of Interest.....	54 66

Total \$3,708,866 60

Less the amount received for rent of property purchased, sale of buildings, wood, meters, and other material, etc. (excepting receipts for water and \$186 received for penalties)..... \$138,003 52 3,570,863 08

The estimated cost of maintenance from January 1, 1872, to September 1, 1874, was 81,650 74

\$3,489,212 34

Deduct estimated amount due water works from sewer department for engineering and office expenses.....	30,600 00
	<u>\$3,458,612 34</u>

The following items, which will be collected, should be deducted from the cost of the works:

City of Providence, Abbott Park Fountain.....	\$708 74	
City of Providence, Public Market	12 00	
Heirs of Joseph Harris, for work on Reservoir avenue	446 81	1,167 55

Cost of construction to September 1, 1874.....	\$3,457,444 79
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Which includes \$226,371.75 paid for land and land and water damages. There is due from A. & W. Sprague Manufacturing Company the sum of \$2,500, which said Company, by written agreement, agreed to pay towards the cost of grading a road in which leading mains are laid, which amount, if eventually collected, should be deducted from the cost of construction.

The plans upon which the works have been constructed are so much changed from those originally estimated upon, that no fair comparison of items can be made between them. The general effect of these changes has been to materially lessen the cost of iron mains and distribution, and to increase the cost of the pumping works. It is believed that each change has increased the value and efficiency of the works, except in the matter of filter-beds. The following comparison is intended to answer the requirements of the resolution, so far as practicable:

LANDS AND DAMAGES.

The original estimates for lands were made by the aforesaid committee and included only such areas and rights of way as would be needed for the permanent use of the works. In negotiating for lands, the Water Commissioners found it desirable to buy whole farms, in some cases, rather than to "take" only such portions as were needed. This was true also of water damages, and the entire privilege at Pawtuxet was bought. It thus happens that while the payments for lands and damages have been large, the city has valuable

real estate and water power that may be sold without injury to the works. The lands which may be sold have very largely increased in value since their purchase. Another cause for the increase under this item was the construction of Hope Reservoir, which required the expenditure for lands of more than half the total amount charged to this account. The whole cost, however, of land and construction for Hope Reservoir is to be balanced against the saving in cost of iron mains and distribution thereby secured.

Original estimate for lands and damages.....	\$52,530 00
COST.	
Hope Reservoir, for land (net).....	\$118,229 65
Sockanosset Reservoir, for land (net).....	14,539 86
Line of leading mains, for land and damages.....	1,645 00
Force main line, for land and damages.....	3,006 35
Real Estate in Warwick (net).....	11,986 80
Water privileges, mill and other real estate in Pawtuxet (net),...	46,392 43
Pettaconset Pumping Station, for land (net).....	25,899 38
Fences and sundries.....	4,632 28
	<u>\$226,371 75</u>
Excess of expenditures to September 1, 1874.....	173,821 75

PUMPING WORKS AT PETTACONSET.

A change of plan in Sockanosset Reservoir—by which, on account of the substitution of a filtering-basin at Pettaconset in place of filter-beds at Sockanosset, a saving of over two hundred thousand dollars was secured, with higher head and greater capacity in the reservoir—involved a change of plan and largely increased cost at the Pettaconset pumping station. A further increase in cost was incurred for the purpose of securing safe and efficient engines of a high duty, by which it is expected that the yearly expenses will be lessened, resulting in greatly increased economy.

Early in the consideration of the plans by the Water Commissioners, the question of the best method of filtering the water was earnestly discussed. The artificial beds which were planned would be expensive and require constant attention in maintenance, while careful borings at Pettaconset indicated “the probability of obtaining a sufficient quantity of clear

water from basins excavated in the sand at a depth below the surface of the river at a comparatively small expense, and without permanent clogging." The commissioners finally determined to try the natural filter basin at Pettaconset, "notwithstanding the possible chance of failure in the scheme and the possible need of constructing the artificial filter-beds at last. Even, however, should it fail as a natural filter-basin, it would probably be worth a considerable portion of its cost as a settling-basin, from which the water, in this case introduced into it by pipes running through the river embankment, would be pumped." The above quotations are from the report of the chief engineer made in January, 1871. It proved that the sand is finer than the borings indicated, and therefore the water runs through it less rapidly than was expected. Enough is probably received, however, for the present wants of the city, and a ready extension may be made by galleries on the Warwick side of the river at moderate expense. A pipe has already been laid through the river embankment, which will form part of a line of communication between the basin and such galleries, should such galleries be constructed.

The original estimate for dam and conduit, pump-well, engine-house and two engines at Pettaconset was	\$288,003 87
There has been expended for these purposes, including filter-basin, the sum of.	395,423 97
Of which it is estimated that one hundred and forty-four thousand dollars have been expended for engine-house and boiler house above the pump-well and the engine-house foundations.	
Excess of expenditures to September 1, 1874.	\$107,420 10
One engine has been in operation there nearly three years, and a second is expected to be running within six months.	

SOCKANOSSET RESERVOIR.

The original estimate for this reservoir with filter-beds was.	\$436,663 69
The amount expended was	233,437 91
Expenditure to September 1, 1874, less than estimate.	\$203,225 68

The available water surface is six and a half feet higher than originally contemplated, and the available capacity is a little more than four million gallons greater.

HIGH SERVICE.

It was originally intended to erect a high-service reservoir of an available capacity of about one million gallons, near East Turnpike, opposite Doyle avenue, but as the head of water contemplated was much less than the commissioners thought necessary for the district, and an increase of head would be very expensive, a change of plan was determined upon, which would dispense with the reservoir and give the required head of water directly from the distribution. Under the present system water is maintained in the high service distribution under a pressure equal to a height of water about thirty-five feet above that originally planned. A reservoir has great value in furnishing a store of water to be drawn upon during hours of excessive demand, whether for fire purposes or for the largest requirements of the day service. If, therefore, a reservoir is dispensed with, the pumping power must be much larger than would otherwise be needed. The original estimates provided for two pumping engines of a capacity of one and a half million gallons each in twenty-four hours, while the present plan provides for two engines of a capacity of five million gallons each in the same time. Duplicate engines, each of the maximum capacity required, are considered to be essential in such a service, for the reason that one engine must inevitably be down for repairs, at times, and the maximum demand is as likely to occur at such a time as at any other. It is usual to estimate the discharge of a fire stream, under about one hundred and seventy-five feet head, at from two hundred to four hundred gallons per minute, depending on the size of nozzle and length of hose. At the test of fire hydrants in Market Square, in November, 1872, when twenty-four streams were played through nozzles from seven-eighths to one and one-fourth inch diameter, it was found that the discharge was probably a little over two hundred gallons per minute for each stream. A few of the hydrants in the High Service are under about twenty-five feet greater head than those on Market Square, and would therefore discharge more water through the same nozzle. At the same rate of dis-

charge as in Market Square, a five million engine will supply about seventeen fire streams, or if a discharge of three hundred gallons per minute is assumed, the engine would supply less than twelve fire streams, even assuming that all other use of water could be cut off during a fire, which is, of course, out of the question. If the head is allowed to run down on the engine, or hydrants located on higher ground are used, a greater number of streams of less force could be supplied. As the demand for water for ordinary service is proved to be, during some hours, about two and a half times greater than at others, it seems clear that after such supply is given, the remaining capacity of a five-million engine is not more than a prudent provision for fire purposes requires.

The original estimate for the high service, exclusive of mains and distribution, was.....		\$189,719 20
Expenditures		168,355 10
Expenditures to September 1, 1874, less than estimate.		\$21,364 10

DELIVERY OF WATER.

The changes in other parts of the works, which increased their cost, very materially lessened the cost of distribution, which originally formed more than three-quarters of the estimated cost of the entire works.

The most important change was the construction of Hope Reservoir, the practical effect of which was to obtain equal efficiency in the supply of water, with smaller pipes. The reservoir amounts to an enlargement of the pipes where it is located, so as to store a supply of water when the demand in the city is small, and give it out when the demand is large. The following extract, from a report of the chief engineer, made January, 1871, will illustrate its operation ;—"A leading main from a reservoir, at a distance of several miles on one side, is required to be of greater capacity, in order to supply the greatest demand without too much loss of head under that rate of flow ; but, with another reservoir lying beyond the centre of distribution, near at hand, on the opposite side a leading main may be of such size as to supply the *average* de-

mand ; for when the draft upon the main exceeds the average quantity, so as to lessen the head upon the pipes, a supply begins to flow from the regulating or storage reservoir, and thus the demand is supplied from both directions through pipes of a combined capacity, sufficient to maintain the required head. Again, when the draft becomes less than the average quantity, the head upon the pipes increases, and the water overflows into the regulating reservoir and is stored there for use during the greater demand." Smaller pipes may also be laid in the distribution, when there is a supply from two directions during great demand.

The original estimate for force mains, leading mains, upper service mains and distribution, was.....	\$3,385,098 42
Expenditures for mains, distribution and Hope Reservoir,.....	\$2,192,999 12
To this may be added the cost of service pipes, drinking fountains, &c., not originally estimated for..	86,969 80 2,279,968 62
Expenditures to Sept. 1, 1874, less than estimate....	\$1,105,129 50

ENGINEERING AND OFFICE EXPENSES.

The various changes on the works very largely increased the necessary engineering expenses, especially in the construction of Hope reservoir and the changes at Pettaconset. This is illustrated in the length of time the works have been under construction, being already nearly five years, while the works, as originally planned, might possibly have been completed in three years. But this increase of time has been of no disadvantage to the water-takers, who began to be supplied about two years after the works were commenced, which, considering the state of the works, is unprecedented, so far as known, except, perhaps, in the case of Brooklyn, where, however, the distribution had been, in great part completed before the water was supplied. The Commissioners have felt that in works of this character and magnitude, the most thorough and careful investigation was essential to a true economy, and they are satisfied that a saving of expense in this department would have resulted in manifold greater expenditures in other ways and in less valuable works.

The original estimate for engineering and office expenses, was....	\$125,000 00
The expenditures have been (net).	141,104 36
<hr/>	
Excess of expenditures over estimate.....	\$ 16,104 36

ITEMS NOT ORIGINALLY ESTIMATED FOR.

Under this head are included :

Three dwelling houses for employés, at Pettaconset, costing....	\$ 9,621 71
One for the keeper at Sockanosset, unfinished, costing thus far....	1,114 32
Three telegraph stations, with connecting lines, costing.....	1,887 99
Sundries	158 76
<hr/>	
Total.....	\$12,782 78

CAPACITY OF WORKS.

The works as constructed have to-day, in some respects, a capacity greater than those originally planned and in others less. In the most important item—that of distribution—the length of water mains laid, is nine and two tenths per cent. greater than at first contemplated, and pipes are on hand sufficient to make the length sixteen and eight-tenths per cent. greater.

The total length of mains and distribution originally estimated for, was.	95.85 miles
The total length laid to October 11th instant, was.....	104.68 miles.
The length of pipe on hand ready to lay, was.....	7.27 miles.
Laid and ready to lay.....	111.95 miles.

The capacity of the works to supply fire streams is very much greater than at first planned. Eight hundred and one fire hydrants had been set to October 11th inst., each having a delivering capacity more than four times as great as the hydrants at first estimated for, of which there were to have been six hundred and eighty-five.

The lands and water power, as before stated, are much in excess of the quantity estimated.

On the other hand it yet remains to complete the engine house and boiler house at Pettaconset; the engine and appurtenances to be erected therein; the Hope Reservoir and the second High-service engine; and to lay the second force main to Sockanosset.

The estimated cost of the work done since the last quarterly report, and to be incurred to lay the pipes now on hand, and the amount still due for pipes delivered, is.....	\$219,942 78
The expenditures necessary to bring all other departments up to the capacity originally planned are estimated at.....	487,422 31
	<hr/> \$707,365 09

Of this amount it is estimated that \$77,450 will be required for the engine house and boiler house at Pettaconset, making the total cost of those buildings above the pump-well and engine house foundations, about \$221,450.

The value of the work done, or included in the above estimated cost, in the departments of mains, distribution and fire supply, above that originally estimated, is estimated at...\$382,780 31

Add value of real estate and water power that may be sold.....	50,000 00	
		432,780 31
Balance.....		\$274,584 78
To be added to cost of works, as above.		3,457,444 79
		<hr/>
Making ?.....		\$3,732,029 57

—which is the estimated cost of completed works of at least equal capacity and efficiency as originally estimated for, [at \$1,477,035 08,] except in the matter of filter-beds and the difference of capacity between the five million engine, first erected at Pettaconset and a nine million engine originally estimated for.

Second :—As to “ *the revenue, thus far, from water, as compared with the revenue from the same number of miles of pipe in other cities, and at the same stage of construction.*”

The Commissioners are not aware that any other city has supplied water generally to takers at the same stage of construction as in Providence. The only case that approaches it within their knowledge is that of Brooklyn, where the contractor, who was under obligations to supply water within a given time, put up a small engine and supplied water about thirteen months before the first permanent engine was ready to run ; the distribution was, however, nearly completed before he did so, and amounted in the next year, at the date of our first definite record, to about one hundred and twenty-four miles. We have no records for proper comparison of income, as the city did not take charge of the works until later.

Records of the works in New York, Boston and Providence enable us to make the following comparison :

	Work begun.	Water Introduced.	Amount expended at time of introduction.	Income.		
				First Year.	Second Year.	Third Year.
New York..	Spring, 1837.	Oct. 5, 1842.	\$12,500,000 00	\$32,053 74	\$84,444 68	\$117,277 86
Boston.....	Aug. 20, 1846.	Oct. 31, 1848.	8,998,051 83	71,637 79	99,025 45	161,052 85
Providence.	May 4, 1870.	Dec. 1, 1871.	1,494,313 10	41,003 51	97,386 09	145,551 68 (?)

The expenditures in Boston and Providence are less credits, which in the latter city, amounted to \$20,621 98. The first year's income in New York was for a supply during seven months. The income in Boston is independent of the public use. The third year's income in Providence is estimated as follows :

Amount collected in first eight months of 1873.....	\$72,144 22
Amount collected in last four months of 1873.....	25,241 '87
	<hr/> \$97,386 09
The collections in last four months were 34.988 per cent. of the collections in the first eight months.	
Amount collected in first eight months of 1874	107,825 65
Estimate for last four months at 34.988 per cent. of first eight months.....	37,726 03
Estimated income for 1874.....	145,551 68
The actual income to the 31st instant, inclusive, was	122,005 05
The total amount of income from water rates at the date of the last quarterly report, was.....	246,215 25

It will be noticed that none of this amount is deducted from the cost of the works.

Third :—As to “ *the probable length of time that will elapse before it will be necessary to erect a second engine at the Pettaconset Pumping Station.*”

The average daily consumption of water in this city at the present time is about two million gallons. It is not probable that a second *permanent* engine will be needed at Pettaconset, until the daily consumption reaches about five million gallons. The length of time that will elapse before such use, can only be conjectured ; perhaps it will be four or five years.

The works were planned for such use of water as other cities have proved to require, but the unprecedented employment of meters here has kept the use of water much less than it would otherwise have been.

Fourth :—As to “*the cost of the stand-pipe to be erected,*” &c.

A contract has been executed with the Rhode Island Locomotive Works for furnishing and erecting this stand-pipe for the sum of twelve thousand dollars. Additional cost for casing and capping will not exceed two thousand dollars. The stand-pipe, (as also the pump-well, foundations and superstructure of engine-house and boiler-house,) will serve for four engines.

The introduction of such a feature as a stand-pipe in the building must necessarily affect the general design ; if any additional expenditure has been incurred on this account, it is included in the amount stated as the cost of engine house.

Fifth :—As to “*the cost of the stand-pipe at the Hope Engine House,*” etc.

No stand-pipe has been erected at Hope pumping station, and none will be required for the second engine for that station, now in process of construction.

Early in the work of constructing Hope Reservoir, and before the engine now running at this station was erected, the commissioners endeavored to obtain from the contractor for the first Hope Engine a release of his right to claim the erection of a stand-pipe at that point, for the reason that they believed it unnecessary and wished to save the expense ; but failing in this, as will be seen by the following letter, they had no alternative but to put in the foundation, which consisted of a small amount of rough rubble masonry. Nothing has been done upon the work within a year.

(Copy.)

[Incorporated June, 1856.]

CORLISS STEAM ENGINE COMPANY,
 George H. Corliss, Treasurer,
 Providence, R. I., 11th May, 1872. }

To Messrs. Moses B. Lockwood, Charles E. Carpenter, Joseph J. Cooke, Water Commissioners:

Gentlemen:—My pending contract for a steam pumping apparatus for the city of Providence, was undertaken with a clear understanding that it was to be used in connection with a "Standing Pipe" for 120 feet "head." Mr. Shedd has proposed to me the substitution of an *Air Chamber* in place of a standing pipe.

Now this is to say that I do not deem either the standing pipe or the air chamber necessary to the proper working of my system, and shall be content to try the apparatus without either of the said appliances, but I do not waive my right to the benefits of the standing pipe, if, after trial, I should be satisfied that it is necessary to the successful working of my apparatus.

Very respectfully yours,

GEORGE H. CORLISS.

Sixth:—As to "*what amount has been paid for marble used in construction, and where located, and what sums have been expended for foreign granite, and where it was obtained.*"

The only marble used in the construction of the works is a slab for a wash bowl at Hope Engine House, the cost of which was fifteen dollars. No foreign granite whatever has been used.

Seventh:—As to "*the number of employes in the Engineering Department,*" etc.

The force in both water and sewer departments, the capacities in which they severally act, and their rates of compensation, are as follows:

WATER WORKS AND SEWERS.

A chief engineer at a salary of \$3,000 per annum.

An assistant engineer, who has general charge of the business of the office, verifies bills and estimates requiring the approval of the chief engineer, and pays off the yard and service pipe employes and all laborers on sewers constructed by the day. Salary, \$3,000 per annum.

A clerk at \$1,000 per annum.

A copyist at \$1.25 per day.

WATER WORKS.

An assistant engineer in charge of operations at Pettaconset Pumping Station, Hope Reservoir and Pumping Station, and Sockanisset Reservoir

Salary, \$3,000 per annum, and an extra allowance of \$85 per month while attending to his duties at both stations.

An assistant engineer, resident at Pettäconset Pumping Station, at \$1,200 per annum and rent of house.

Two students at same place, at \$300 each per annum.

An axeman at same place, at \$2.00 per day.

Two assistant engineers at Hope Reservoir, one each at \$1,200 and \$1,000 per annum.

Two students, at same place, at \$400 each per annum.

A time-keeper and handy-man, at same place, at \$3.00 per day.

An assistant engineer on distribution, at \$1,200 per annum.

Two students on same work, one each at \$500 and \$400 per annum.

An assistant engineer in the office, on plans, service and miscellaneous work, at \$1,000 per annum.

A mechanical engineer, at \$200 per month.

A service pipe engineer, at \$1,000 per annum.

SEWERS.

An assistant engineer in charge of designs, plans, records and general office business of sewers and private drain connections, at a salary of \$2,500 per annum.

An assistant engineer in general charge of construction (field work) at \$2,500 per annum.

Two assistant engineers on construction, one each at \$1,200 and \$1,000 per annum.

Two assistant engineers on field and office work, one at \$1,000, and one working afternoons only at \$500 per annum.

Two students at \$500 each, and one at \$400 per annum.

One handy-man (field work) at \$2.00 per day.

Two draughtsmen and general assistants, at \$1.50 per day each.

One engineer of private drain connections, at \$100 per month.

One temporary assistant to above, at \$3 per day.

Two clerks, one at \$1,000 per annum and one at \$2.25 per day.

Eighth:—As to "*the accessibility of all contracts*," etc.

The Commissioners do not remember that any case has ever occurred in which a citizen has been denied opportunity to examine a contract *after* its execution. An examination of records has never been denied excepting when containing a record of proposals for furnishing work and materials, the *contract* for doing which had not been executed. The "Ordinance in Relation to Water Commissioners and Water Works," approved September 20, 1869, provides that "the contents of no proposal shall be made known to any person not a member of the commission until after a contract shall have been made." While, therefore, pleasure is taken in affording information to parties interested in the work, it is

not conceded that the transaction of business in the several departments should be impeded by improper demands upon the time of the Commissioners or their employes.

Ninth:—As to "*the comparative merits and cost of Scotch and other pipes,*" etc.

The essential points of a good sewer pipe are, strength to withstand external pressure; the ability to resist the chemical action of sewage acids and gases upon its inner surface, and of the earth in which it may be imbedded; true shape and interior smoothness.

The pipe mainly in use by this department is the Scotch vitrified stone-ware pipe, the excellence and durability of which is undisputed. We have also used the vitrified pipe of several different American manufacturers, which usually have less strength, and also cost less (the best of them by from six to nine cents per foot for twelve-inch pipe, and nine to fifteen cents per foot for fifteen-inch pipe). This difference in cost is a small percentage on the completed sewer, as the cost of excavating, backfilling, laying, paving, etc., is the same, whatever the pipe used. With one or two exceptions, the American makers use the slip-glaze, which allows the use of poorer clay and less complete burning than is necessary for pipe of a reliable character. The salt-glazed pipe must be of good clay and thoroughly burned to make a perfect glaze, and, at the same time, a sound pipe of true form. We have never laid cement pipe, so-called, made of cement and sand, for reasons which appear in this statement.

As, according to the tests of time and science and the judgment of the best engineers of this country, well made vitrified stone-ware or clay pipes, and in an eminent degree, the Scotch, possess all the requisites for sewerage uses, the question as to comparative merits may best be answered by stating the objectionable features of cement pipe.

Weakness.—When our present Point street sewer was built, in 1872, a line of cement pipes was taken up that had been

laid about a year. The contractor was to have these pipes, but many of them would not hold together to be taken out, and the attempt to save them was abandoned.

In excavating for a new sewer in Friendship street, in this city, early last month, a line of six-inch cement drain pipes was taken out, some of which were examined and found to be so soft that a pick-point lightly struck on the top would penetrate it half an inch, and the bottom was not as hard as some kinds of dry, unbaked clay. It is not known when they were laid.

The city surveyor of Hartford, in 1872, says: "I have long been convinced of their utter worthlessness, as now made, and our experience in taking up several lately has borne the strongest proof of the correctness of my opinion. We have had occasion to remove quite a number of small pieces, one of which had only been laid a little more than a year, and the others a longer time, and in every case we have found them either smashed in the ground or else so far gone that with the greatest care they could not be removed from the trench."

In Taunton, a portion of a cement pipe sewer, through which only clear water flowed, was uncovered for examination, to determine the question as to further use of that kind of pipe. It was found to be honey-combed and in so weak a condition that brick had to be substituted.

John P. Culver, chief engineer, Board of Public Works, of Jersey City, says: "Cement pipe never will answer a safe purpose until it can be manufactured so as not to become disintegrated after being laid in the trench and covered. I have known a sewer to cave in built of it, and make a most disagreeable state of affairs from the fact of not knowing to what extent the break extended."

The city surveyor of Newark, N. J., has used them and finds they break easily.

Large cement pipes have been found broken into several pieces in Indianapolis.

The city engineer of Springfield, Ill., says that they are

seldom of uniform texture and are very easily broken ; don't consider them safe or durable, while the vitrified pipe is as lasting as time.

While it is true that some cement pipes may, and occasionally do, prove durable under the service to which they have been subjected, there is always an uncertainty attending their use, which cannot be said of the Scotch pipe, and perhaps some American brands of vitrified pipe.

E. S. Chesbrough, city engineer of Chicago, and the highest authority on the subject of sewerage in this country, says that while some cement pipes have laid twenty years, and are still in good condition, others have failed in less than three years ; and further, that it is very difficult, if not impossible, to be certain with regard to the quality of a cement pipe, while it is not so with regard to hard-burnt clay. He says in conclusion : " Cement pipes have been slowly disintegrated by certain gases and acids emptied into them. Some very striking instances of this kind occurred in San Francisco, where urine from privies was discharged into the cement pipes. Nothing of this kind has ever occurred, so far as I can learn, with well-burnt pipes. My opinion is that hard burnt or vitrified clay pipe should be preferred for sewerage purposes to cement pipe, because of the much greater certainty of getting a good article of the former than of the latter ; and in this respect I have the concurrence of several distinguished members of my profession, who have come to their conclusion on the subject after years of observation and experience."

City engineer Smedley, of Philadelphia, says of cement pipe, that although somewhat cheaper than vitrified pipe, there is so much uncertainty in them that he would not be willing to risk their general introduction. " Cases have been reported to me of cement pipes where they have all had to be taken up on account of their deterioration."

The city engineer of Patterson, N. J., does not believe care is taken to have the cement pipes of uniform texture, and that if sufficient water is used to make the mass homo-

geneous, the time required to have the pipes properly made and the cement well set and seasoned, would make the cost of cement pipe equal to vitrified.

N. Henry Crafts, formerly city engineer of Boston, says he regards cement pipe as worthless unless made of the best materials, and even then it is not as good as the vitrified—would use the latter notwithstanding the difference in cost.

The superintendent of sewers in Boston says that one of the worst features of the use of cement pipe is the uncertainty of its quality,—no sample test being possible.

The city engineer of Pittsburgh is of the opinion that if the proper quality of materials is used, and their thorough manipulation and proper “setting” is secured, cement pipe *may* stand, otherwise the most unsatisfactory results will be obtained. He would not like to risk it on any extensive work.

The city surveyor of New Haven, where cement pipe has been somewhat extensively used, confesses to a feeling of uneasiness, and thinks the time may come when it will be found that the experiment was tried on too large a scale.

Susceptibility to Chemical Action.—About five years ago, Professor S. W. Johnson, of Yale College, reported as follows to the mayor of New Haven, on the comparative merits of salt-glazed Scotch pipe and cement pipe: “The cement pipe becomes lined, indeed, with a greasy coating which, doubtless, would hinder the subsequent action of acid, but the solubility of the cement is nevertheless a most serious objection in a sewer pipe, which must be laid down and repaired at heavy cost, and which ought, therefore, to be made of the most durable materials. I have also examined the salt-glazed stoneware pipes. These appear to unite every quality of material requisite for a good sewer pipe.

“They are exceedingly hard and fine in texture, and are well coated on both sides with the salt-glazing, which is nearly the same thing as a coating of glass, and is as nearly insoluble and indestructible by acid and alkali as anything which the arts produce that can be employed in sewer pipes.

"The salt glazed pipes deserve the preference, especially as their expense is not much greater than that of the cement pipes."

In Philadelphia, in 1871, Thomas Shaw, a well known engineer, immersed separately in the strongest sulphuric acid, two samples each of Scotch and American vitrified clay and cement pipe. They remained immersed about three months, when, on examination, the Scotch and American vitrified pipe were found to be in no way affected, while the cement pipe showed the disintegrating effects of the acid in its corroded surface, and in the separated particles of cement and sand with which the bottom of the vessel was thickly covered.

Charles A. Putnam, a civil engineer of Salem, Mass., reports the following case which came under his notice: In 1869, some cement pipe drains owned by the Naumkeag Steam Cotton Company, and through which privy sewage was discharged, were uncovered to make connections, when they were found to be in very bad condition, the bottom of the pipes being in about as soft a state as the matter flowing through them, and would fall out when the pipes were lifted from their beds. The pipes leading from the houses were in a better condition and are still in use. These pipes were made under the Knight patent, and were laid in 1865-6.

Cement pipes have been condemned in New York City, Chicago, Cincinnati, Toledo, Washington, Minneapolis, Little Rock and other localities, for the specific reason that they will sooner or later become disintegrated by the action of sewage acids, gases, etc.

In Washington, cement pipes, uncovered by a change of grade, were found to be in such a state of decomposition that they could not be taken up whole.

In Jersey City, in 1872, quite a number of cement pipes were uncovered, all of which were more or less disintegrated on the outside.

In Rochester, cement pipes that had been down only one year were found to be unfit to relay.

Several cases of the destruction of cement pipes by acids,

urine and house drainage, have come to the knowledge of our chief engineer.

Less than one-fourth of our large cities use cement pipes. Some that formerly did so have abandoned the practice; among them Jersey City, St. Louis, Hartford, Erie, Toledo, Baltimore and Richmond.

Besides these, the following cities do not use cement pipes: Washington, which, in 1872, laid seventy miles of pipes, nearly one-half of which (and the most satisfactory portion) were Scotch; Paterson, N. J., where the use of Scotch is required by ordinance; Philadelphia, New York, Pittsburgh, Chicago, Columbus, Cincinnati, Alleghany, Lancaster, Springfield, Ill., Minneapolis, Fort Wayne, Little Rock, Lawrence, Kan., Augusta, Lynn, and others.

It is understood that the following cities use cement pipe: Brooklyn, Portland, Cambridge, New Haven (less than formerly), Newburg, Buffalo, Harrisburg, Cleveland and the Newark Aqueduct Board. Boston has used all kinds, but now favors vitrified.

The present cost of Scotch pipes, delivered in this city, is 74 cents per foot for 12-inch, and \$1.15 per foot for 15-inch.

The cost for American vitrified pipes varies from 52 cents to 68 cents per foot for 12-inch, and 92 cents to \$1.06 per foot for 15-inch, the smaller prices being conditioned on the purchase of large quantities.

The original bill of some 12-inch cement pipe bought in this city for the purpose of making tests, gave the price as 60 cents per foot net, but a new bill at 50 cents per foot net was afterwards sent in.

In the purchase of Scotch and American vitrified pipes, we have dealt with seven different parties—four in New York, two in Boston and one in New Haven.

Of the total length of sewers constructed during the last four years, sixty-six per cent. is of the Scotch and American vitrified pipes, sixty-two per cent. being Scotch: the remaining thirty-four per cent. is of brick. Included in the total amount laid are the catch-basin connections, which somewhat increase the proportion of pipe to brick sewers.

Tenth.—As to “*the depths and sizes of our sewers, as compared with the larger cities of this country.*”

Until recently the standard depth for our sewers,—measured to the inside crown of the arch,—has been eight and a half feet below the level of the curbstone. This depth was adopted in concession to popular prejudice on the subject, but recent experience in this city, and further information as to the experience of other cities, have induced the commissioners to change the standard depth to ten feet, which is believed to be none too great for the most efficient and economical results. In some parts of the city it is impossible to obtain this depth,—nor, in cases, even half of it,—on account of the height of the tide, it being in no instance allowed to construct the sewer so as to be continually under water, nor can this standard depth be uniformly adhered to in other parts of the city, as a proper grade, or fall, must be maintained, however irregular the surface of the ground: and in streets like Congdon and Benefit, the depth should be such as to admit of a proper fall for house drains from estates on the lower side of the street, that on account of their location, can have no other means of drainage. In Congdon and Benefit streets the sewers are sixteen feet deep, but there are cellars now built on both those streets that are too deep to be drained into the new sewers. A less depth than the standard adopted, while it would answer for surface drainage, would generally render the work of little value for house sewerage or for that very important service of lowering the stagnant water about the foundations of buildings.

In New York, the general grade of street sewers is thirteen feet below the level of the curb.

In Brooklyn, the present practice is to lay the brick sewer invert thirteen feet and the pipe sewer invert twelve feet below grade of street.

(The measurements for depth are generally given to the invert.)

In Boston, the ruling depth for suburban sewers is about nine feet, and for business purposes twelve feet, or ten feet clear, to the highest water line in the sewer.

In Jersey city it is the rule, where possible, to arrange the water run of sewers twelve feet below curb grade.

In Newark, N. J., the sewers generally are about thirteen feet below the street grades, that depth being considered sufficient for ordinary cellars. Some of the sewers are much deeper, and many, *on low ground*, are of less depth.

In Philadelphia, the depths of the sewers are such that the bottom of the house-connection pipe must enter the sewer, (usually at the springing line of the arch), at a depth of eight and one-half feet below curb level, which would bring the bottom of a three feet circular sewer ten feet below the curb level.

In Cleveland, the *minimum* depth of main sewers is twenty feet, which, on account of the very uneven topography of that city, necessarily carries some portions of the sewer much deeper; and for branch sewers, twelve feet is the minimum depth, unless it be in exceptional cases.

In Cincinnati, the general depth of brick or main sewers is fifteen feet, and of pipe or lateral sewers, thirteen feet.

In Chicago, twelve feet to the bottom of the sewer, and sometimes more, is considered very desirable, but they are often compelled to make nine feet, and even less, answer, in low streets.

In St. Louis, on account of the topography of the city, the trunk sewers vary from ten to sixty feet in depth. The main sewers or channels of drainage, into which the lateral sewers discharge, are generally sixteen feet deep; and the district or lateral sewers about twelve feet. Greater depths are now demanded than in former years.

Information in regard to the depth of sewers in other countries, is contained in the report on sewerage made to the board of aldermen in February of this year.

The proportion of our small sewers (twelve and fifteen inches in diameter) to the total length of all sizes constructed, is sixty-three per cent.

In Brooklyn, these sizes amount to seventy and one-half per cent., of which, according to the latest reports by which a comparison can now be made, something less than one half are of cement pipes.

The later New York sewer reports fail to give total construction by sizes. Previous to 1865 pipe sewers were not laid in that city, and of course the proportion of large sewers was considerable. By the report for 1865 it appears that of the length of sewers planned for eight drainage districts, eighty-three per cent. was to be of twelve to eighteen inch vitrified stoneware pipe. In the five years ending with 1872, sixty-seven per cent. of the total length of sewers built in New York was of pipe. The former per centage, it will be seen, (and probably the latter) include eighteen inch pipe, which, in Providence, amounts to only a fraction over one per cent. of the total length laid.

Late Boston reports do not give summaries of all sewers laid ; but of total length constructed during the years 1872 and 1873, the proportion of twelve and fifteen inch was forty-eight and two thirds per cent.

In Chicago, the proportionate length of twelve and fifteen-inch sewers, is thirty-three and two-thirds per cent ; but on account of the flatness of the territory, and the necessarily slight grades of the sewers, much larger sectional areas are required than in a city like Providence, where the grades are steeper, and smaller pipes have the same capacity, and will do equally efficient service as larger ones in the former locality.

In Worcester, the proportionate length of sewers, fifteen inches and smaller, including 2,233 feet of nine inch, is forty-nine and one third per cent.

Eleventh:—As to "*the depths of our sewer outlets, with reference to the tides ; and the cases of damage, if any, resulting from the overflow of tide water from the sewers into the basements of buildings ; and, if any, the cause of such damage, and the proper remedy therefor.*"

With two exceptions the bottoms of these outlets are one foot or more above low tide, and are therefore entirely emptied of tide water twice in twenty-four hours.

The exceptional cases are those of Dorrance street, where the large size of the sewer and the flat grade of the street made

it necessary to put the bottom of the outlet only six inches above low tide ; and the intercepting sewer which is a little less than a foot above. The larger outlets are never entirely submerged by ordinary high tides. .

We are not aware that the tide will rise any higher, with reference to cellars, in deep sewers than in shallow ones.

Only one case of injury resulting from the overflow of tide water from a sewer into the basement of a building has come to our knowledge. In that case, we are informed that an occupant of the premises propped open a tide valve with a stick, designing to let the water out faster, and left the valve so for the tide to flow through into the cellar on its next rise. The proper remedy for such injury is to leave sticks out of the valves.

No claims for damages can lie against the city on account of injury by reason of private sewer connections, as each owner of an estate connecting with a sewer is required to sign an application before a permit to connect is issued, containing the following clause :

"And the undersigned further agrees that no claim for damages which may be occasioned to such estate, or any property thereon, in any manner, by the construction, use or existence of such drain or connection, shall be made against the city."

Twelfth :—As to "*the amount of deposit in the sewers,*" etc.

From November 17th, 1873, (when the present superintendent of cleaning began service,) to September 30th, 1874, 7,400 feet of the 57,875 feet of the new sewers under his charge required cleaning ; and the amount of deposit taken out was 4,518 cubic feet, or less than eight per cent. of a cubic foot per running foot of the total length of sewers. In nearly every case, those portions of the sewers below high water mark are, and have been from the first, kept entirely clean by the action of the tides.

During the same time, 2725 feet of the 37,500 feet of the old drains required cleaning, and the amount of deposit taken out was 8,081 cubic feet, or about twenty-one and a half per cent. of a cubic foot per running foot of the total length of

drains. Those portions of the old drains requiring to be cleaned, were in most cases full or nearly so. A general cleaning of old sewers had previously been made.

It will be seen that the proportion of deposit in the new sewers to that in the old drains was, per foot, as 8 to 21.

A large proportion of the cleaning of the new sewers has been made necessary by deposits left in them during their construction; or during or immediately after the construction of sewers discharging into them. This was *entirely* the case in North Main street, where eighteen days and four hours labor were spent on the upper end of the sewer this season, which is the longest time that has been given to any one sewer. Earth is sometimes carried into the sewers during the construction of private drains.

The new sewers receive their surface drainage through catch-basins at the sides of the streets, by means of which catch-basins as much as possible of solid matter is kept out of the sewers. In the case of the old drains, there are some small catch-basins, but generally there are only chutes of no retaining capacity. In the old drains, however, there are large chambers where a portion of the deposits, which have passed through the catches or chutes, settles.

The deposits taken from the catch-basins of the new sewers, amount to 48,091 cubic feet.

The deposits taken from the sand-catchers of the old drains, amount to 4,471 cubic feet, and from the chambers of the old drains, 21,269 cubic feet have been taken, a portion of which would, but for them, have remained as deposit in the sewers, and the balance been discharged into the harbor.

Thirteenth;—As to "*the method employed for cleaning the sewers,*" etc.

The method mainly relied upon for cleaning the sewers, is flushing with water from the hydrants. The rush of water carries the accumulations along to the manholes, where they are stopped by temporary dams and taken out. Sewers of sufficient size for laborers to enter are either flushed or cleaned

by the use of a shovel adapted to the purpose. In five streets where sand had been washed into the sewers from new sewer trenches, or on account of extraordinary circumstances, an apparatus designed to be dragged through the sewers, has been used to gather the material. The total length of time during which this was employed on the five streets was about fourteen days. This apparatus has not been used on North Main street for more than a year. The sewers rarely need cleaning, except where earth has been washed in from other new work.

Fourteenth: As to "*the condition and capacity of the stone sewers taken up, their total length, with the sizes and kinds of sewers substituted therefor.*"

This question seems to imply a right of discretion on the part of the Commissioners, as to whether or not to take up old stone drains. The Commissioners never had such right, but have been positively directed in each case by the Board of Aldermen, or by the City Council, to construct new sewers where the old ones existed. The order itself indicates dissatisfaction with the old stone drains, and the Commissioners, in putting in new sewers, have built such as they believed the locality demanded, quite independent of the size or depth of the old drains. When the construction of sewers under the present system was begun, the work was ordered by the Board of Aldermen, and for more than two years it was the practice to submit plans to the Board, giving sizes and locations of the proposed sewers, before the work was ordered by the Board. The system was thus established and endorsed by the city government, and at the time when the mode of ordering sewers was changed, an elaborate report upon the sewerage system was, by order of the Board of Aldermen, published and distributed to members of the government and to citizens generally. The Commissioners have never received any intimation, from either branch of the city government, that the plans are not fully approved, and after such long and public notice of their character, it seems proper to conclude that the system is endorsed in every particular by the City Council.

The following table gives the comparison called for as far as practicable:

OLD DRAINS TAKEN UP OR SUPERSEDED.

STREETS.	SIZES.	LENGTHS.	CONDITION.	SIZES SUBSTITUTED.
Angell.....	2'6" x 1'8"	200 ft.	Fair.	12-inch pipe.
Thayer	20" x 30" brick	60	Good.	22" circular brick.
	15" pipe.	440	Good.	22" circular brick.
Star	2'6" x 1'8"	315	Fair.	15-inch pipe.
Pearl.....	3'8" x 3'4"	2,211	Good.	505 ft. of 38" x 57" brick. 1,198 ft. of 36" x 54" brick. 508 ft. of 24" x 36" brick.
Washington ...	3'6" x 3'0"	400	Fair.	22" circular brick.
Dorrance.....	4'0" x 3'6"	1,120	Good.	66" circular brick.
Westminster... 4'0" x 3'6"		1,978	Good.	639 ft. of 22" brick. 434 ft. of 18" pipe. 307 ft. of 15" pipe. 578 ft. of 12" pipe.
Fountain.....	4'6" x 4'0"	25	Good.	12" pipe.
Brook.....	4'0" x 4'0"	1,680	Fair.	380 ft. of 32" x 48" brick. 1,300 ft. of 28" x 42" brick.
Wickenden....	4'0" x 4'0"	160	Fair.	20" circular brick.
Ship.	2'6" x 1'3"	440	Fair.	12" pipe.

A part of the old drain in Pearl street, (six hundred feet,) was left in the ground, but is no longer used.

The new brick sewers, not specified as circular, are egg-shaped.

The old sewer in Thayer street was ordered to be taken up, because of its insufficient depth, and the new one was laid six to seven feet deeper.

The old drain in Westminster street contained six inches to three feet in depth of very offensive matter. Those in Washington, Pearl, Dorrance and Wickenden streets, contained some mud, and the one in Ship street about three inches of sand.

The capacity of stone sewers, as compared with pipe or brick, cannot be given by sizes; the rate of fall and the *smoothness* of the conduit enter very largely into the question.

Experiments have proved that with the same size and fall, a rough conduit, (smooth, however, as compared with a stone drain) requires twice the head or force to discharge a given quantity of water that is required by a smooth one.

Fifteenth:—As to “*whether any sewers have been constructed which were not ordered by the City Council,*” etc.

There has been no case of the construction of a sewer where one was not ordered by the proper branch or branches of the city government.

It has been the practice from the beginning of the work on sewers by this commission, whether acting as Commissioners or as a committee of the Board of Aldermen, to run spurs from the main line under construction to the lateral streets, so that when sewers shall be laid in those streets, the work can be connected without disturbing the street in which the main is laid. Such spurs were always represented in finished plans furnished to the Board of Aldermen.

Sixteenth:—As to “*the kind of pipe which parties connecting with sewers are required to use.*”

There has as yet, been no restriction upon the kind of pipes used by such parties, except that it shall be reasonably free from liability to destruction, where it would injure the public sewers, and especially where it is located within the public highway. Parties have selected such pipe answering this requirement as they chose, usually that of American manufacture, and we are not aware that any Scotch pipe has been used for the purpose in the city.

Question by Alderman Clarke:—“What motives influenced the Water Commissioners to place a Cornish engine at Pettaconset, instead of a Worthington?”

*Answer:—*In the quarterly report of the commissioners, April 1, 1871, in speaking of the Worthington engine, they say: “The height of suction made necessary by our plans in order to be secure from injury by freshets in the Pawtuxet, (at least 12 feet,) added to the depth of the natural filter basin, precludes its permanent use at Pettaconset, even if there was no doubt otherwise of its superiority to the Cornish.”

•

The Commissioners now add that the much larger duty which they believe that the Cornish engine, constructed in accordance with their plans, will perform, will result in great economy in use, at any rate when the demand for water shall be fairly proportioned to its capacity.

JOSEPH J. COOKE,	} Board of Water Commissioners.
CHAS. E. CARPENTER,	
WILLIAM CORLISS,	

MASS. STATE BOARD OF HEALTH,
ENGINEER'S OFFICE.
CITY DOCUMENT.

1875.

No. 37.

SIXTH REPORT
OF THE BOARD OF
WATER COMMISSIONERS
OF THE
CITY OF PROVIDENCE.

[Elected February 27, 1874.]

ON

SEWERS,

SEPTEMBER 1, 1875.



PROVIDENCE:

ANGELL, FURLINGAME & CO., PRINTERS TO THE CITY.
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ORGANIZATION.
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT.

CHARLES E. CARPENTER,

WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.

Office No. 35 North Main Street.

CHIEF ENGINEER.

J. HERBERT SHEDD.

Office No. 35 North Main Street.

REPORT.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
PROVIDENCE, R. I., September 1, 1875. }

TO THE HONORABLE, THE CITY COUNCIL :

The Board of Water Commissioners, elected February 27th, 1874, respectfully present their Sixth Quarterly Report on Sewers :

Since the date of the last report, the following sewers have been ordered by the City Council to be constructed :

Amos street, from North Main street to the river.

Arnold street, from the summit between Benefit and Thayer streets to Brook street.

Arnold street, from East street to Governor street.

Beacon and Maple streets, from Prince street to Pearl street.

Borden street, from Hospital street to Eddy street.

Bridgham street, from Cranston street to Central street.

Brown street, from Barnes street to Olney street.

Clemence street, from Washington street to Fountain street.

Prairie avenue and Prince street, from Friendship street to Pearl street.

Vinton street, from Asia street to Broadway.

By resolution of the City Council, approved June 18, 1875, further proceedings in the construction of a sewer in *Peace street, from Broad street to Prairie avenue*, were directed to

be suspended "until such street is accepted and declared a public highway by the board of aldermen." No work had been done in the construction of this sewer.

The following sewers have been completed since the date of the last report, but the accounts are not yet in readiness for a statement of their cost :

Arnold street, from Benefit street easterly to summit between Benefit street and Thayer street.

Beacon street, from Pine street to Broad street.

Beacon and Maple streets, from Prince street to Pearl street.

Borden street, from Hospital street to Eddy street.

Bridgham, Central and Pearl streets, from summit in Bridgham street east of Central street to Broad street.

Carpenter and Battey streets, from Ringgold street to Fountain street.

Clemence street, from Washington street to Fountain street.

College street, from Benefit street to Prospect street.

Crary street, from Plane street to Mary street.

George street, from Cooke street to Brook street.

High street, from Battey street to Knight street.

High, Courtland, Carpenter and Fountain streets, from Almy street to Jackson street.

Hospital street, from Crary street to Borden street.

Keene street, from Prospect street to Thayer street.

Knight street, from Carpenter street to Washington street.

Knight street, from the summit between Cranston and High streets to High street.

Langley street, from Plane street to Hospital street.

Lemon street, from Carpenter street to Fountain street.

Newton street, from summit between Atwell's avenue and Federal street to Atwell's avenue.

Pine street, from summit near Seekell street to Pearl street.

Prairie avenue, from Public street to Pearl street.

Prairie avenue and Prince street, from Friendship street to Pearl street.

Richmond street, from Elm street to Point street.

South street, from Plane to Chestnut street, and from Chestnut to Richmond street.

Sutton street, from summit between Asia and Lee streets to Broadway.

The accounts in relation to the following sewers, heretofore reported as completed, are not yet in readiness for a statement of their cost :

Benevolent and Benefit streets, from Brown street to College street.

Chapel and Snow streets, from Burrill street to Westminster street.

Dyer street, from Market square to Orange street.

Middle street, from Eddy street to Dorrance street.

South Water street, from College street to the river, at foot of Crawford street.

Thayer street, from Bowen street to Angell street, and through Angell and Brook streets to the river.

Transit street, from Mohawk Alley to Benefit street.

The following sewers ordered by the City Council, are in a state of progress as follows :

Borden street, from Plane street to Hospital street ; completed from Hospital street to Mary street. Catch-basins not to be built until street is graded.

Bridgham street, from Cranston street to Central street ; completed except curves and catch-basins.

Brown street, from Barnes street to Olney street ; trench opened from Olney street to near Halsey street. No sewer yet laid.

Courtland street, from Carpenter street to Broadway ; work commenced on the 30th ultimo.

Dawson, Brighton and Knight streets, from Marshall street to Carpenter street ; completed from Carpenter street to within 100 feet of Courtland street, except two catch-basins.

High, Knight, Washington and Battey streets, from Courtland street to Fountain street ; completed from Fountain street to High street, except two catch-basins.

Olney street, from Mallett street to North Main street ; completed except curve into Brown street and three catch-basins.

Vinton street, from Asia street to Broadway ; completed except two catch-basins.

Work on the following sewers, (completing the list ordered to be constructed by the Board of Water Commissioners,) has not been commenced :

Amos street, from North Main street to the river.

Arnold street, from East street to Governor street.

Arnold street, from the summit between Benefit and Thayer streets to Brook street.

Custom House street, from Weybosset street to Dyer street.

Assessments for the following sewers have been completed and certified to the City Treasurer :

<i>Arnold street, from Benefit street easterly to summit between Benefit street and Thayer street,</i>	\$609 99
<i>Beacon street, from Pine street to Broad street,</i>	602 38
<i>Benevolent and Benefit streets, from Brown street to College street,</i>	3,747 23
<i>Bridgham, Central and Pearl streets, from summit in Bridgham street, east of Central street to Broad street,</i>	4,176 26
<i>Charles and West River streets, from Randall square to Walling street,</i>	4,608 64
<i>Clemence street, from Washington street to Fountain street,</i>	436 26
<i>College street, from Benefit street to Prospect street,</i>	1,855 17
<i>Crary street, from Mary street to Plane street,</i>	1,350 26
<i>Dyer street, from Market Square to Orange street,</i>	2,501 15
<i>George street, from Cooke street to Brook street,</i>	2,389 33
<i>Hospital street, from Crary street to Borden street,</i>	436 95
Amount carried forward,	<hr/> \$22,713 62

Amount brought forward,	\$22,713 62
<i>Keene street, from Prospect street to Thayer street, - - - - -</i>	3,519 64
<i>Langley street, from Plane street to Hospital street, - - - - -</i>	3,265 29
<i>Newton street, from summit between Atwell's avenue and Federal street to Atwell's avenue, -</i>	222 99
<i>Pettis street, from Palmer street to Walling street, - - - - -</i>	580 54
<i>Pine street, from summit near Seekell street to Pearl street, - - - - -</i>	3,549 30
<i>Prairie avenue, from Public street to Pearl street, - - - - -</i>	7,875 83
<i>Prairie avenue and Prince street, from Friendship street to Pearl street, - - -</i>	3,465 52
<i>Richmond street, from Elm street to Point street, - - - - -</i>	577 85
<i>South street, from Plane to Chestnut street and from Chestnut to Richmond street, - -</i>	3,647 12
<i>South Water street, from College street to the river at foot of Crawford street, - -</i>	655 23
<i>Sutton street, from summit between Asia and Lee streets to Broadway, - - -</i>	2,095 12
<i>Walling and Nichols streets, from West River street to Charles street, - - -</i>	2,708 34
<i>West River street, from a point about 65 feet northeasterly from Walling street to Walling street, - - - - -</i>	226 92
	<hr/>
	\$55,053 31

Drain-Layers' licenses have been issued during the last quarter, as follows :

George L. Burlingame,	Willard F. Inman,
George M. Carr,	John Keogh,
Alexander O'Toole.	

The total number of such licenses issued, to date, is fifty-nine.

A schedule of sewer bills approved by the Board of Water Commissioners, from June 1, 1875, to August 31, 1875, inclusive; a trial balance of the Board of Water Commissioners' Ledger, Sewer Department, August 31, 1875, inclusive; a trial balance of the Ledger of the Committees appointed by the Board of Aldermen to build certain sewers August 31, 1875, inclusive, and a schedule of receipts by the Board of Water Commissioners, paid to the City Treasurer from June 1, 1875, to August 31, 1875, inclusive, are hereunto appended and made parts of this report.

JOSEPH J. COOKE,	}	<i>Board of Water Commissioners.</i>
CHAS. E. CARPENTER,		
WILLIAM CORLISS,		

SCHEDULE OF BILLS APPROVED BY THE BOARD OF WATER
COMMISSIONERS, SEWER DEPARTMENT, FROM JUNE 1, 1875,
TO AUGUST 31, 1875, INCLUSIVE.

1280	William H. Smith, salary as inspector on sewers,	100 00
1281	Duty J. Greene, " " "	104 00
1282	Henry F. Davis, " " " on sewers,	104 00
1283	C. Frank Allen, " " " of sewer pipes,	100 00
1284	Allen Aldrich, " " superintendent of cleaning and repairs,	100 00
1285	James L. Sherman, " " inspector on sewers,	45 60
1286	William Whittaker, " " " " "	110 00
1287	Thomas R. Belcher, " " " " "	100 00
1288	Henry L. Ripley, " " " " "	164 00
1289	Lucius J. Sampson, " " engineer of private drains,	100 00
1290	William Bowler, " " inspector on sewers,	104 00
1291	Thomas F. Crandall, " " " " "	104 00
1292	William H. Kelly, testing cement,	35 77
1293	Warren S. Burnap, " " "	35 33
1294	Henry Wright, " " "	30 00
1295	Hopkins & Pomroy, bricks,	810 00
1296	Allen Aldrich, horse hire, &c.,	26 00
1297	L. J. Sampson, horse hire,	78 00
1298	Robert Morrow, horse hire by engineers,	186 00
1299	Charles H. Pierce, paid by him for sundries,	41 21
1300	Providence and Stonington Steamship Co., freight of sewer pipes,	608 17
1301	G. W. Rader & Co., invert blocks, sewer pipes, &c.,	782 43
1302	O. O. Bowman & Co., sewer pipes,	618 85
1303	George B. Inman, on account for constructing sewer in High, Courtland, Carpenter and Fountain streets,	3,400 00
1304	Alfred Mundell, on account for constructing sewer in Benefit and Benevolent streets,	2,500 00
1305	Alfred Mundell, on account for constructing sewer in Dyer st.,	3,000 00
1306	Patrick Smith, on account for constructing sewer in Bridgham, Central and Pearl streets,	3,350 00
1307	Gilmore & Judge, on account for constructing sewer in Prairie Avenue,	3,825 00
1308	Willard F. Inman, on account for constructing sewer in Pine st.,	575 00
1309	W. A. Burdick, Agent, catch basin stones,	819 00
1310	Fuller Iron Works, iron sewer castings,	947 03
1311	E. M. Hunt, cement,	17 94
1312	George B. Inman, extra labor, &c.,	182 58
1313	Henry Blundell, Agent, labor and materials repairing fountain pipe,	259 51
1314	Charles H. Pierce, paying laborers, &c.,	1,250 24
1315	Charles H. Pierce, on account for paying laborers,	200 00
1316	Steamship William Kennedy, freight of sewer pipe, (charged to George C. Hicks & Co.,)	18 25
	Amount carried forward,	24,831 91

	Amount brought forward,	24,831 91
1317	Sloop Fred Brown, freight of sewer pipes, (charged to G. W. Rader & Co.,)	33 75
1318	A. Waite, teaming,	21 25
1319	Hopkins & Pomroy, teaming,	252 72
1320	Hopkins & Pomroy, cement, carting bricks, &c.,	1,788 93
1321	Schooner George F. Brown, freight of sewer pipes, (charged to R. G. Walmsley,)	108 77
1322	Bark Charlotte, freight of sewer pipes, (charged to William Nelson, Jr.,)	961 86
1323	Schooner H. C. Acken, freight of sewer pipes, (charged to R. G. Walmsley,)	40 82
1324	Providence & Stonington Steamship Co., freight of sewer pipes, (charged to Akron Sewer Pipe Co.,)	633 16
1325	Providence Water Works, wharfage and labor,	2,327 18
1326	James A. Whitbeck, bricks,	1,254 32
1327	Alfred Mundell, labor, sewer in Dyer street,	10 90
1328	W. S. Fifield, canal barrows, &c.,	8 88
1329	Willard F. Inman, extra labor, sewer in Pine street,	24 76
1330	Barker, Whitaker & Co., tools, &c.,	30 77
1331	William H. Miller & Co., dressing stone tools, &c.,	25 75
1332	J. W. and J. J. Newman, constructing sewer in South Water st.,	50 93
1333	Akron Sewer Pipe Co., sewer pipes,	1,167 45
1334	Gilmore & Judge, constructing sewer in Prairie Avenue,	2,324 79
1335	Schooner Lucian, freight of sewer pipes, (charged to William Nelson, Jr.,)	109 67
1336	Alfred Mundell, constructing sewer in Benevolent and Beneficents,	357 66
1337	Alfred Mundell, " " " Dyer street,	444 76
1338	Bernard Swift, " " " Newton street,	204 76
1339	Charles H. Pierce, paying laborers, &c.,	1,183 18
1340	Charles H. Pierce, on account for paying laborers, &c.,	200 00
1341	Alfred Mundell, constructing sewer on Richmond street,	954 50
1342	Sloop General Warren, freight of sewer pipes, (charged to William Nelson, Jr.,)	88 45
1343	Schooner William H. Bowen, freight of invert blocks, (charged to G. W. Rader & Co.,)	105 00
1344	Henry F. Davis, salary as inspector on sewers,	104 00
1345	C. Frank Allen, " " " of sewer pipe,	100 00
1346	Henry L. Ripley, " " " on sewers,	120 00
1347	William H. Smith, " " " of sewer pipe,	100 00
1348	Henry A. Spicer, " " " on sewers,	63 00
1349	Thomas F. Crandall, " " " " "	104 00
1350	Duty J. Greene, " " " " "	104 00
1351	George H. DeForest, " " " of private drains,	18 00
1352	Rencellaer B. S. Hart, " " " " " "	60 00
1353	Lucius J. Sampson, " " engineer " " "	100 00
1354	Allen Aldrich, " " superintendent of cleaning and repairs,	100 00
1355	William Whittaker, salary as inspector on sewers,	100 00
1356	Thomas R. Belcher, " " " " " "	100 00
1357	William Bowler, " " " " " "	104 00
	Amount carried forward,	40,823 88

REPORT ON SEWERS.

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	Amount brought forward,	\$40,823 88
1358	James L. Sherman, salary as inspector on sewers,	78 00
1359	Warren S. Burnap, testing cement,	22 95
1360	William H. Kelly, " "	23 40
1361	Allen Aldrich, horse hire,	78 00
1362	Lucius J. Sampson, horse hire,	78 00
1363	Charles H. Pierce, paid by him for sundries,	23 49
1364	Alfred Mundell, labor and materials,	294 21
1365	Robert Morrow, horse hire by engineers,	165 00
1366	Providence and Stonington Steamship Co., freight of sewer pipe, (charge to Akron Sewer Pipe Co.),	305 90
1367	William H. Miller & Co., dressing stone tools, &c.,	23 45
1368	Hopkins & Pomroy, bricks,	805 00
1369	Gilmore & Judge, extra labor, sewer in Prairie Avenue,	33 70
1370	N. Webber, rubber boots,	13 20
1371	W. A. Burdick, Agent, catch basin stones,	338 00
1372	George B. Inman, on account for constructing sewer in Lemon st.,	375 00
1373	George B. Inman, " " " " " " Beacon st.,	200 00
1374	George B. Inman, " " " " " " High, Courtland, Carpenter and Fountain streets,	5,000 00
1375	John O'Donnell, on account for constructing sewer in Langley street,	275 00
1376	J. W. & J. J. Newman, " " " " sewer in College st.,	850 00
1377	Patrick Smith, " " " " " " Keene st.,	1,175 00
1378	Patrick Smith, " " " " " " Sutton st.,	400 00
1379	Patrick Smith, constructing sewer in Bridgham, Central and Pearl streets,	995 27
1380	Willard F. Inman, constructing sewer in Crary street,	649 65
1381	Willard F. Inman, constructing sewer in Pine street,	1,592 81
1382	Thomas Phillips & Co., rubber hose, &c.,	12 63
1383	Fuller Iron Works, iron sewer castings,	1,422 33
1384	Fuller Iron Works, " " "	516 48
1385	Alfred Mundell, labor, sewer in Benefit and Benevolent streets,	10 46
1386	George B. Inman, extra labor and materials,	54 56
1387	E. M. Hunt, cement,,	277 38
1388	R. G. Walmsley, sewer pipe, &c.,	1,331 45
1389	William Nelson, Jr., sewer pipe, &c.,	9,486 87
1390	Schooner S. L. Thompson, freight of sewer pipe, (charged to R. G. Walmsley),	242 34
1391	Charles H. Pierce, paying laborers,	1,328 90
1392	Charles H. Pierce, on account for paying laborers,	100 00
1393	Gideon G. Hicks, labor and materials on boiler, &c.,	105 58
1394	A. C. Eddy & Studleys, rubber boots and coat,	22 75
1395	Allen Waite, teaming,	13 75
1396	Hopkins & Pomroy, teaming,	332 75
1397	John H. Eddy, manilla bags, &c.,	6 58
1398	Barker, Whitaker & Co., tools, &c.,	12 64
1399	Wood & Winsor, repairing tools, &c.,	5 36
1400	J. W. & J. J. Newman, extra labor, sewer in College street,	23 23
1401	Wightman & Liscomb, oil, &c.,	4 68
	Amount carried forward,	\$69,929 63

	Amount brought forward,	\$69,929 63
1402	Patrick Smith, extra labor, sewer in Bridgham, Central and Pearl streets,	39 93
1403	Henry W. Ellis, repairing tools,	9 37
1404	William Nelson, Jr., sewer pipe,	4,087 92
1405	George W. Hall & Co., cement, &c.,	1,230 81
1406	Akron Sewer Pipe Co., sewer pipe,	2,706 90
1407	George B. Inman, constructing sewer in Beacon street,	172 05
1408	George B. Inman, " " Arnold street,	288 09
1409	Edward Burr, repairing harness,	6 75
1410	Hopkins & Pomroy, cement, carting bricks, &c.,	810 04
1411	G. W. Rader & Co., invert blocks, &c.,	678 10
1412	Schooner Sarah Elizabeth, freight of sewer pipe, (charged to R. G. Walmsley),	120 16
1413	Charles H. Pierce, on account for paying laborers,	100 00
1414	Charles H. Pierce, paying laborers, &c.,	1,389 45
1415	Schooner B. F. Brainerd, freight of sewer pipe, (charged to G. W. Rader & Co.),	50 00
1416	Dexter Gorton & Co., inspector's poles, &c.,	8 20
1417	George C. Hicks & Co., sewer pipe,	184 45
1418	Providence Builders' Association, cement,	67 50
1419	Hammond, Angell & Co., printing,	42 63
1420	J. W. & J. J. Newman, constructing sewer in College street,	274 58
1421	W. A. Burdick, Agent, catch-basin stones,	809 88
1422	C. Frank Allen, salary as inspector of sewer pipes,	100 00
1423	Allen Aldrich, " " superintendent of cleaning and repairs,	100 00
1424	Lucius J. Sampson, salary as engineer of private drains,	100 00
1425	Rencellaer B. S. Hart, salary as inspector of private drains,	80 00
1426	Robert Morrow, horse hire by engineers,	153 00
1427	Providence Concrete Co., gravel (charge to George B. Inman),	18 00
1428	Providence and Stonington Steamship Co., freight of sewer pipe,	226 20
1429	Henry A. Spicer, salary as inspector on sewers,	75 00
1430	Warren S. Burnap, testing cement,	20 25
1431	William H. Kelly, " " " "	58 50
1432	Henry F. Davis, salary as inspector on sewers,	104 00
1433	Duty J. Greene, " " " " " "	104 00
1434	Henry L. Ripley, " " " " on sewers,	120 00
1435	Thomas F. Crandall, salary as inspector on sewers,	104 00
1436	William Bowler, " " " " " "	104 00
1437	William H. Smith, " " " " of sewer pipe,	104 00
1438	James L. Sherman, salary as inspector on sewers,	91 00
1439	Alfred E. Martin, " " " " " "	77 00
1440	William Whitaker, " " " " " "	100 00
1441	Thomas R. Belcher, " " " " " "	100 00
1442	Henry Staples & Co., tarred paper, &c.,	6 06
1443	George B. Inman, on account for constructing sewer in High, Courtland, Carpenter and Fountain streets,	5,300 00
1444	George B. Inman, on account of reservations, sewer in High, Courtland, Carpenter and Fountain streets,	500 00
1445	George B. Inman, on account for constructing sewer in George street,	1,000 00
	Amount carried forward,	\$91,751 44

REPORT ON SEWERS.

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	Amount brought forward,	\$91,751 44
1446	J. W. & J. J. Newman, on account for constructing sewer in Olney street,	3,725 00
1447	Patrick Smith, on account for constructing sewer in Beacon and Maple streets,	650 00
1448	John O'Donnell, constructing sewer in Langley street,	1,086 70
1449	Willard F. Inman, on account for constructing sewer in High, Knight, Washington and Batley streets,	625 00
1450	Gilmore & Judge, on account for constructing sewer in Carpenter and Batley streets,	1,375 00
1451	Bernard Swift, on account for constructing sewer in Dawson, Brighton and Knight streets,	525 00
1452	Bernard Swift, constructing sewer in Knight street from Washington to Carpenter street,	329 39
1453	Patrick Smith, constructing sewer in Sutton street,	581 34
1454	Patrick Smith, " " " Keene street,	1,429 55
1455	Charles H. Pierce, on account for paying laborers,	100 00
1456	Charles H. Pierce, paying laborers, &c.,	1,317 00
1457	Sloop Deception, freight of sewer pipes, (charged to R. G. Walmsley,)	74 57
1458	E. M. Hunt, cement,	901 14
1459	George B. Inman, extra labor, sewer in High, Courtland, Carpenter and Fountain streets,	102 23
1460	Gilmore & Judge, extra labor, sewer in Carpenter and Batley sts.,	23 17
1461	Allen Fire Department Supply Co., rubber hose and repairing hose,	29 00
1462	Wood & Winsor, repairing hose cart,	9 50
1463	Hopkins & Pomroy, carting bricks, &c.,	513 51
1464	Fuller Iron Works, iron sewer casting,	1,115 12
1465	Barker, Whitaker & Co., tools, &c.,	30 23
1466	Lucius J. Sampson, horse hire,	78 00
1467	Allen Aldrich, horse hire, &c.,	72 75
1468	Hopkins & Pomroy, teaming,	313 50
1469	William H. Miller & Co., dressing stone tools, &c.,	15 83
1470	Providence Water Works, salaries and office expenses, &c.,	510 59
1471	S. A. Thornton, lumber and labor,	18 77
1472	John Mason, engineering instruments, templets, &c.,	23 56
1473	Allen Fire Department Supply Co., one pair wheels,	35 00
1474	Hopkins & Pomroy, bricks,	4,095 00
1475	Charles H. Pierce, paid by him for sundries,	24 72
1476	E. G. Walmsley, sewer pipe,	3,875 25
1477	Akron Sewer Pipe Co., sewer pipe,	555 26
1478	Providence and Stonington Steamship Co., freight of sewer pipe, (charged to Akron Sewer Pipe Co.,)	147 25
1479	Waldo Brothers, sewer pipe,	43 75
1480	G. W. Rader & Co., invert blocks and sewer pipe,	1,114 08
1481	Alfred Mundell, constructing sewer in Clemence street,	331 97
1482	Charles H. Pierce, paying laborers, &c.,	2,211 52
1483	Charles H. Pierce, on account for paying laborers,	100 00
1484	H. B. Leach & Sons, reservation, sewer in Angell street,	65 10
1485	Wightman & Liscomb, oil, meal, &c.,	9 04
		<u>\$119,934 83</u>

TRIAL BALANCE OF BOARD OF WATER COMMISSIONERS'
LEDGER, SEWER DEPARTMENT, AUGUST 31, 1875.

Dr.	
Books, stationery, etc.,	\$39 50
Traveling expenses of commissioners,	51 62
Building on Cove Lands,	129 15
Stones from Brook street sewer,	2,123 31
Carting stones from sewers to Cove lands,	1,932 62
Supplying water for sewer work,	648 17
Iron rods,	35 02
Iron sewer connections,	75 30
Invert blocks,	3,241 00
Catch-basin covers,	1,013 35
Catch-basin traps,	580 43
Manhole frames and covers,	5,377 50
Manhole stones,	249 10
Catch-basin stones,	9,217 76
Sewer pipes, rings, covers, etc.,	33,125 50
Bricks,	19,706 51
Lamphole frames and covers,	447 16
Sheet piling,	443 32
Shed for storing materials,	132 13
Sewer pipe experiments,	75 80
Inspection of sewer pipe,	709 58
Inspection of catch-basin stones,	26 18
Inspection of connections,	3,771 19
Superintendence of cleaning and repairs,	2,191 55
Cleaning catch-basins and sewers,	11,013 32
Cleaning and repairing old sewers,	5,676 02
Repairing new sewers,	2,750 22
Testing cement,	1,659 23
Sundries,	110 67
Printing,	2,494 62
Centres, forms, templets, etc.,	203 50
Tools,	4,990 81
Salaries and office expenses,	14,031 66
City Treasurer,	4,377 27
Additional catch-basins,	683 71
Additional work on sewers,	1,003 27
Catch-basins in Exchange street and Exchange place,	511 89
Catch-basins in Hope street,	775 64
Catch-basin in Park street,	66 99
Catch-basin in Benefit street near Thomas street,	51 46
Catch-basin corner of Eddy and Ship streets,	59 21
Alterations caused by change of grades,	598 59
Amount carried forward,	\$136,402 83

REPORT ON SEWERS.

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Amount brought forward,	\$136,402 83
Sewer in Thayer, Angell and Brook streets,	82,944 24
" " Transit street, from Mohawk alley to Benefit st.,	288 51
" " High, Courtland, Carpenter and Fountain sts.,	7,701 46
" " Middle street from Eddy to Dorrance street,	499 05
" " Benevolent and Benefit streets,	4,422 27
" " South Water street, from College to Crawford st.,	1,345 02
" " Chapel and Snow streets,	1,112 12
" " Bridgham, Central and Pearl streets,	5,955 83
" " Prairie avenue, from Public to Pearl street,	8,443 98
" " South street, from Plane to Richmond street,	3,079 50
" " Keene street, from Prospect to Thayer street,	3,067 61
" " Dyer street, from Market square to Orange street,	4,408 89
" " Pine street, from near Seekell to Pearl street,	2,732 81
" " Newton street, from near Federal street to Atwell's avenue,	273 53
" " Richmond street, from Elm to Point street,	1,125 69
" " Sutton street, from near Asia st. to Broadway,	1,275 31
" " Langley street, from Plane to Hospital street,	1,782 17
" " College street, from Benefit to Prospect street,	1,419 11
" " Lemon street, from Carpenter to Fountain street,	96 91
" " Beacon street, from Broad to Pine street,	481 95
" " Crary street, from Plane to Mary street,	736 92
" " Hospital street, from Crary to Borden street,	269 39
" " Dawson, Brighton and Knight streets,	633 64
" " Arnold street, from Benefit street, easterly to its summit,	361 60
" " Prairie avenue and Prince street,	2,177 00
" " Olney street from Mallett to North Main street,	260 62
" " Carpenter and Battay streets,	290 88
" " Beacon and Maple streets,	174 13
" " Knight street, from Carpenter to Washington st.,	442 54
" " High, Knight, Washington and Battay streets,	196 91
" " George street, from Cooke to Brook street,	410 42
" " Borden street from Plane to Eddy street,	3 00
" " Clemence street, from Washington to Fountain st.,	353 45
" " Vinton street, from Asia street to Broadway,	1 95
" " Knight street, from High street, southerly, to its summit,	94
George B. Inman, for High, Courtland, Carpenter and Fountain street,	15,148 20
George B. Inman, for Lemon street, from Carpenter to Fountain street,	375 00
George B. Inman, for George street, from Cooke to Brook street,	1,001 37
Willard F. Inman, for High, Knight, Washington and Battay streets,	633 25
Bernard Swift, for Knight street, from Brighton to Carpenter street,	525 00
Amount carried forward,	292,865 00

Amount brought forward,	\$292,865 00
Bernard Swift, for Knight street, from High street, south- erly, to its summit,	12 62
J. W. & J. J. Newman, for Olney street, from Mallett to North Main street,	3,738 10
Gilmore & Judge, for Carpenter and Battay streets,	1,394 17
Patrick Smith, for Beacon and Maple streets,	650 00
Union Railroad Co.,	20 55
City of Providence, Highway Department,	777 13
Thomas Phillips & Co.,	114 55
John Gillen,	15 30
O. O. Bowman & Co.,	2 00
Charles H. Pierce,	100 00
Completed Sewers,	385,673 71
Engineering Department, for horse hire,	2,162 85
“ “ “ books, stationery, etc.,	35 49
“ “ “ sundries,	517 92
“ “ “ printing,	449 19
“ “ “ advertising,	32 37
“ “ “ labor,	672 58
“ “ “ instruments,	188 69
“ “ “ brick arch experiments,	72 95
	<hr/> \$ 689,485 17

CR.

H. B. Leach & Sons, for Thayer, Angell and Brook sts.,	\$1,954 72
“ “ “ “ “ Benefit and Wickenden streets,	283 60
“ “ “ “ “ Brown and Charles Field streets,	126 82
Bernard Swift, for Transit street, from Mohawk Alley to Benefit street,	10 00
“ “ “ Chapel and Snow streets,	45 00
“ “ “ Newton street, from near Federal street to Atwell's avenue,	10 00
“ “ “ Knight street, from Carpenter to Wash- ington street,	15 00
John O'Donnell & Co., for Middle street, from Eddy to Dorrance street,	20 00
John O'Donnell, for Langley street, from Plane to Hos- pital street,	70 00
Alfred Mundell, for Benevolent and Benefit streets,	109 24
“ “ “ Dyer street, from Market square to Orange street,	167 25
“ “ “ Richmond street, from Elm to Point street,	48 35
“ “ “ Clemence street, from Washington to Fountain street,	18 80
J. W. & J. J. Newman, for South Water street, from Col- lege to Crawford street,	40 19
“ “ “ “ “ College street, from Prospect to Benefit street,	60 00
Amount carried forward,	<hr/> \$2,978 97

REPORT ON SEWERS.

19

Amount brought forward,	\$2,978 97	
Patrick Smith, for Bridgham, Central and Pearl streets,	235 00	
“ “ “ Keene street, from Prospect to Thayer street,	135 00	
“ “ “ Sutton street, from near Asia street to Broadway,	42 65	
Gilmore & Judge, for Prairie avenue, from Public to Pearl street,	365 00	
Willard F. Inman, for Pine street, from near Seekel to Pearl street,	115 00	
“ “ “ “ Crary street, from Plane to Mary st.,	35 00	
George B. Inman, for Beacon street, from Broad to Pine st.,	20 00	
“ “ “ “ Arnold street, from Benefit street, easterly, to its summit,	15 00	
W. A. Burdick, Agent,	646 34	
Akron Sewer Pipe Co.,	694 75	
Approved bills,	684,202 46	
		\$689,485 17

TRIAL BALANCE OF LEDGER, COMMITTEES APPOINTED BY THE
BOARD OF ALDERMEN TO CONSTRUCT CERTAIN SEWERS,
AUGUST 31, 1875.

DR.

Dorrance street, from Westminster to Broad street, etc.,	10,424	36
Dorrance street, from Westminster street to the river,	13,206	82
Thomas Pearson, for Dorrance street, from Westminster street to the river,	18,970	15
Approved bills,	338,654	55
		<u>\$381, 255 88</u>

CR.

Thomas Newman, for Pearl street, from Broad to Mum- ford street,	1,590	36
Approved bills,	379,665	52
		<u>\$381,255 88</u>

RECEIVED BY THE BOARD OF WATER COMMISSIONERS, SEWER
DEPARTMENT, FROM JUNE 1, 1875, TO AUGUST 31, 1875, INCLU-
SIVE, AND PAID TO THE CITY TREASURER.
1875.

July 30.	Of Providence Water Works, for labor and materials,	81	91
	Of James Blackwood and others, for labor and materials,	18	79
August 28.	Of Commissioners to build a bridge across Providence river, for stones from Brook street sewer,	651	00
	Of Superintendent of Public Bridges, for stones from Brook street sewer,	412	50
	Of Commissioners of the Brook street District, for pumping and cleaning out cellar,	10	00
	Of Fuller Iron Works, for old iron,	6	80
31.	For labor, filling cisterns with Pawtuxet water, &c.,	20	05
			<u>\$1,201 05</u>

MASS. STATE BOARD OF HEALTH,
1875.] CITY DOCUMENT [No. 48
ENGINEER'S OFFICE.

SEVENTH REPORT

OF THE BOARD OF

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE.

[Elected February 27, 1874.]

ON

SEWERS,

DECEMBER 1, 1875.



PROVIDENCE:

ANGELL, BURLINGAME & CO., PRINTERS TO THE CITY.
1875.

1875.]

CITY DOCUMENT.

[No. 48.]

SEVENTH REPORT
OF THE BOARD OF
WATER COMMISSIONERS
OF THE
CITY OF PROVIDENCE.
[Elected February 27, 1874.]
ON
SEWERS,
DECEMBER 1, 1875.



PROVIDENCE:
ANGELL, BURLINGAME & CO., PRINTERS TO THE CITY.
1875.

ORGANIZATION
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT.

CHARLES E. CARPENTER,

WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.

Office No. 35 North Main Street.

CHIEF ENGINEER.

J. HERBERT SHEDD.

Office No. 35 North Main Street.

REPORT.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
PROVIDENCE, R. I., December 1, 1875. }

TO THE HONORABLE THE CITY COUNCIL.

The Board of Water Commissioners, elected February 27th, 1874, respectfully present their Seventh Quarterly Report on Sewers :

Since the date of the last report, the following sewers have been ordered by the City Council to be constructed :

Atwell's avenue, from Acorn street to Dean street.

Benefit street, from Angell street to College street.

Broad, Somerset and Pine streets, from Bridgham street to Pearl street.

Carpenter street, from Fountain street to Battey street.

Eagle street, from Atwell's avenue to the Woonasquatucket river.

Eddy street, from Broad street to Pine street.

Federal street, from Bradford street to Broadway

Friendship, West Friendship and Dudley streets, from Greenwich street to Plane street.

Greenwich, Burnett and Public streets, from Daboll street to the low point on Public street between Burnett and Austin streets.

Lane nearly opposite Star street, from North Main street to the Moshassuck river.

Lippitt street, from Camp street to North Main street.

Olive street, from the summit between Prospect and Thayer streets to Thayer street.

Orms and Charles streets, from the railroad bridge on Orms street to Mill street.

North Main, Hewes and Stevens streets, from Olney street to the Moshassuck river.

Pearl street, from Cranston street to Central street.

Peck street, from Weybosset street to Dyer street.

Plane and Blackstone streets, from Dudley street to tide water.

Pond street, from Summer street to Fenner street.

Pond street, from the summit between Spring and Winter streets to Pearl street.

Pond street, from summit between Spring and Winter streets through Summer and Broad streets to Pearl street.

Ship and Dyer streets, from Richmond street to Dorrance street.

Thayer street, from George street to Charles Field street.

Thayer street, from Waterman street to George street.

Tower street, from Atwell's avenue to Federal street.

Vinton street, from Vernon street to Carpenter street.

The resolution of the City Council ordering a sewer to be constructed in *North Main, Hewes and Stevens streets, from Olney street to the Moshassuck river*, was approved on the 30th day of September. On the 4th day of November the Board of Aldermen directed the Commissioners "to cause a main drain or common sewer to be constructed through land of Roswell R. Rickard, Thomas Mullen, the City of Providence, and the heirs of Arnold Whipple, from Lippitt street to Hewes street," and on the 15th day of November, the City Council, by resolution approved on that day, directed the Commissioners to "discontinue the construction of so much of the sewer ordered in North Main, Hewes and Stevens streets, as lies between Lippitt street and the junction of Hewes and Stampers streets."

The sewers ordered in *Eagle street, and Greenwich, Burnett and Public streets*, are for surface drainage only, and the expense thereof is to be charged to the appropriation for highways.

The following sewers have been completed since the date of the last report, but the accounts are not yet in readiness for a statement of their cost :

Amos street, from North Main street to the river.

Arnold street, from the summit between Benefit and Thayer streets to Brook street.

Arnold street, from East street to Governor street.

Benefit street, from Angell street to College street.

Bridgham street, from Cranston street to Central street.

Brown street, from Barnes street to Olney street.

Carpenter street, from Fountain street to Battey street.

Courtland street, from Carpenter street to Broadway.

Custom House street, from Weybosset street to Dyer street.

Dawson, Brighton and Knight streets, from Marshall street to Carpenter street.

Eddy street, from Broad street to Pine street.

Federal street from Bradford street to Broadway.

Greenwich, Burnett and Public streets, from Daboll street to the low point on Public street between Burnett and Austin streets.

High, Knight, Washington and Battey streets, from Courtland street to Fountain street.

Lane nearly opposite Star street, from North Main street to the Moshassuck river.

North Main, Hewes and Stevens streets, from Olney street to the Moshassuck river.

Olney street from Mallett street to North Main street.

Orms and Charles streets, from the railroad bridge on Orms street to Mill street.

Pearl street from Cranston street to Central street.

Peck street, from Weybosset street to Dyer street.

Pond street, from summit between Spring and Winter streets, through Summer and Broad streets to Pearl street.

Pond street from Summer street to Fenner street.

Thayer street, from George street to Charles Field street.

Vinton street, from Asia street to Broadway.

Vinton street, from Vernon street to Carpenter street.

The accounts in relation to the following sewers, heretofore reported as completed, are not yet in readiness for a statement of their cost :

Arnold street, from Benefit street easterly to summit between Benefit street and Thayer street.

Beacon street, from Pine street to Broad street.

Beacon and Maple streets, from Prince street to Pearl street.

Benevolent and Benefit streets, from Brown street to College street.

Borden street, from Hospital street to Eddy street.

Bridgham, Central and Pearl streets, from summit in Bridgham street, east of Central street to Broad street.

Carpenter and Battey streets, from Ringgold street to Fountain street.

Chapel and Snow streets, from Burrill street to Westminster street.

Clemence street, from Washington street to Fountain street.

College street, from Benefit street to Prospect street.

Crary street, from Plane street to Mary street.

Dyer street, from Market Square to Orange street.

George street, from Cooke street to Brook street.

High street, from Battey street to Knight street.

High, Courtland, Carpenter and Fountain streets, from Almy street to Jackson street.

Hospital street, from Crary street to Borden street.

Keene street, from Prospect street to Thayer street.

Knight street, from Carpenter street to Washington street.

Knight street, from the summit between Cranston and High streets to High street.

Langley street, from Plane street to Hospital street.

Lemon street from Carpenter street to Fountain street.

Middle street, from Eddy street to Dorrance street.

Newton street, from summit between Atwell's avenue and Federal street to Atwell's avenue.

Pine street, from summit near Seekell street to Pearl street.

Prairie avenue, from Public street to Pearl street.

Prairie avenue and Prince street, from Friendship street to Pearl street.

Richmond street, from Elm street to Point street.

South street, from Plane to Chestnut street, and from Chestnut to Richmond street.

South Water street, from College street to the river, at foot of Crawford street.

Sutton street, from summit between Asia and Lee streets to Broadway.

Thayer street, from Bowen street to Angell street, and through Angell and Brook streets to the river.

Transit street, from Mohawk Alley to Benefit street.

The following sewers ordered by the City Council, are in a state of progress as follows :

Borden street, from Plane street to Hospital street ; completed except catch-basins.

Atwell's avenue, from Acorn street to Dean street ; work commenced 29th ultimo.

Olive street, from the summit between Prospect and Thayer streets, to Thayer street ; nearly completed.

Lippitt street, from Camp street to North Main street ; six hundred feet of sewer and four catch-basins built.

Broad, Somerset and Pine streets, from Bridgham street to Pearl street ; about 1090 feet of sewer built.

Plane and Blackstone streets, from Dudley street to tide water ; about one hundred feet of sewer built.

Thayer street, from Waterman street to George street ; nearly completed.

Eagle street, from Atwell's avenue to the Woonasquatucket river ; nearly completed.

Work on the following sewers, (completing the list ordered to be constructed by the Board of Water Commissioners,) has not been commenced :

Friendship, West Friendship and Dudley streets, from Greenwich street to Plane street.

Pond street, from the summit between Spring and Winter streets to Pearl street.

Ship and Dyer streets, from Richmond street to Dorrance street.

Tower street, from Atwell's avenue to Federal street.

Assessments for the following sewers have been completed and certified to the City Treasurer:

Beacon and Maple streets, from Prince street to

<i>Pearl street,</i>	-	-	-	-	\$5,230 69
<i>Borden street, from Hospital street to Eddy street,</i>					279 38
<i>Borden street, from Plane street to Hospital street,</i>					2,780 06
<i>Carpenter and Battey streets, from Ringgold street to Fountain street,</i>	-	-	-	-	2,429 26
<i>High, Courtland, Carpenter and Fountain streets, from Almy street to Jackson street,</i>	-	-			13,875 16
<i>Lemon street, from Carpenter street to Fountain street,</i>	-	-	-	-	529 60
<i>Vinton street, from Asia street to Broadway,</i>	-				1,524 69
					<hr/>
					\$26,648 84

A schedule of sewer bills approved by the Board of Water Commissioners, from September 1, 1875, to November 30, 1875, inclusive; a trial balance of the Board of Water Commissioners' Ledger, Sewer Department, November 30, 1875, inclusive; a trial balance of the Ledger of the Committees appointed by the Board of Aldermen to build certain sewers, November 30, 1875, inclusive, and a schedule of receipts by the Board of Water Commissioners, paid to the City Treasurer from September 1, 1875, to November 30, 1875, inclusive, are hereunto appended and made parts of this report.

JOSEPH J. COOKE,	}	<i>Board of Water Commissioners.</i>
CHAS. E. CARPENTER,		
WILLIAM CORLISS,		

REPORT ON SEWERS.

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SCHEDULE OF BILLS APPROVED BY THE BOARD OF WATER COMMISSIONERS, SEWER DEPARTMENT, FROM SEPTEMBER 1, 1875, TO NOVEMBER 30, 1875, INCLUSIVE.

1486	C. Frank Allen,	salary as inspector of sewer pipes,	100 00
1487	Lucius J. Sampson,	" " engineer of private drains,	100 00
1488	Allen Aldrich,	salary as superintendent of cleaning and repairs,	100 00
1489	Duty J. Greene,	" " inspector,	104 00
1490	Henry F. Davis,	" " " on sewers,	104 00
1491	Thomas F. Crandall,	salary as inspector on sewers,	48 00
1492	James L. Sherman,	" " " " " "	91 00
1493	William Bowler,	" " " " " "	96 00
1494	Henry L. Ripley,	" " " " " "	120 00
1495	Alfred E. Martin,	" " " " " "	28 00
1496	Henry A. Spicer,	" " " " " "	85 75
1497	William H. Smith,	" " " " " "	84 00
1498	Thomas R. Belcher,	" " " " " "	100 00
1499	William Whittaker,	" " " " " "	100 00
1500	William H. Kelly,	testing cement,	59 17
1501	Warren S. Burnap,	" " " " " "	27 00
1502	Rencellaer B. S. Hart,	salary as inspector of private drains,	80 00
1503	Lucius J. Sampson,	horse hire,	78 00
1504	Allen Aldrich,	" " &c.,	81 50
1505	A. C. Eddy & Studleys,	rubber boots and coat,	38 50
1506	Fuller Iron Works,	iron sewer castings,	1,100 75
1507	Bernard Swift,	extra labor and materials,	43 67
1508	Robert Morrow,	horse hire by engineers,	153 00
1509	Henry Blundell, Agent,	repairing fountain pipes,	15 00
1510	Hopkins & Pomroy,	bricks,	2,712 00
1511	E. M. Hunt,	cement,	263 58
1512	Charles H. Pierce,	paid by him for sundries,	22 15
1513	William H. Miller & Co.,	dressing stone tools, &c.,	21 18
1514	Bernard Swift,	constructing sewer in Knight street, from High street southerly to its summit,	466 12
1515	Leach & Co.,	on account for constructing sewer in Borden street,	975 00
1516	Willard F. Inman,	on account for constructing sewer in High, Knight, Washington and Battey streets,	1,475 00
1517	Bernard Swift,	on account for constructing sewer in High street, from Battey street to Knight street,	600 00
1518	J. W. & J. J. Newman,	on account for constructing sewer in Olney street,	1,925 00
1519	Patrick Smith,	on account for constructing sewer in Bridgham street,	1,300 00
1520	Patrick Smith,	on account, for constructing sewer in Beacon and Maple streets,	1,175 00
1521	Patrick Smith,	on account for constructing sewer in Vinton street, from Asia street to Broadway,	500 00
Amount carried forward,			\$14,372 77

	Amount brought forward,	\$14,372 77
1522	Patrick Smith, on account, for constructing sewer in Courtland street,	50 00
1523	W. A. Burdick, Agent, catch-basin stones,	823 50
1524	George B. Inman, extra labor, sewer in High, Courtland, Carpenter and Fountain streets,	3 33
1525	Barker, Whitaker & Co., tools, &c.,	58 18
1526	Hopkins & Pomroy, bricks, cement, cartage, &c.,	1,144 80
1527	Schooner Urbana, freight of sewer pipes, (charged to G. W. Rader & Co.,)	121 60
1528	Schooner Adelaide, freight of sewer material, (charged to Wm. Nelson, Jr.,)	53 00
1529	Charles H. Pierce, paying laborers, &c.,	2,000 58
1530	Schooner Katrina Van Courtland, freight of bricks, (charged to Haight & Southard,)	142 50
1531	Charles H. Pierce, on account for paying laborers,	200 00
1532	H. B. Leach & Sons, reservation, sewer in Brown and Charles Field streets,	115 19
1533	Schooner Florence, freight of bricks, (charged to D. J. Haight,)	196 25
1534	Akron Sewer Pipe Co., sewer pipe,	306 69
1535	Albert Dailey & Co., lumber, &c.,	58 56
1536	George Campbell, sand screen, riddle, &c.,	12 00
1537	George W. Hall & Co., cement, pipes, &c.,	343 00
1538	Providence Water Works, wharfage and labor, &c.,	4,201 82
1539	Gilmore & Judge, constructing sewer in Carpenter and Battey streets,	146 76
1540	George W. Smith, cutting catch-basin stones,	25 88
1541	Willard F. Inman, extra labor,	34 81
1542	Patrick Smith, constructing sewer in Vinton street, from Asia street to Broadway,	62 24
1543	Bernard Swift, constructing sewer in High street, from Knight street to Battey street,	24 49
1544	Bernard Swift, constructing sewer in Knight street, from Brighton street to Carpenter street,	105 54
1545	Charles H. Pierce, paying laborers, &c.,	2,027 73
1546	Charles H. Pierce, on account for paying laborers,	200 00
1547	H. B. Leach & Sons, contract reservation sewer in Benefit and Wickenden streets,	232 07
1548	Pietro J. Bernadini, damage by flooding cellar (charged to Leach & Co.,)	20 00
1549	Leach & Co., constructing sewer in Borden street,	574 51
1550	Schooner Gloucester, freight of sewer materials, (charged to R. G. Walmsley,)	35 05
1551	Patrick Smith, extra labor on sewers,	22 13
1552	Lucius J. Sampson, salary as engineer of private drains,	100 00
1553	Rencellaer B. S. Hart, " " inspector of private drains,	80 00
1554	C. Frank Allen, " " " " sewer pipes,	100 00
1555	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
1556	Duty J. Greene, salary as inspector on sewers,	104 00
1557	William Bowler, " " " " " "	104 00
	Amount carried forward,	\$23,302 58

REPORT ON SEWERS.

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	Amount brought forward,	\$28,302 58
1558	William Whittaker, salary as inspector on sewers,	63 33
1559	Thomas R. Belcher, " " " " "	100 00
1560	Henry L. Ripley, " " " " "	120 00
1561	Henry F. Davis, " " " " "	64 00
1562	William H. Smith, " " " " "	88 00
1563	James L. Sherman, " " " " "	31 50
1564	William H. Kelly, testing cement,	58 72
1565	Lucius J. Sampson, horse hire,	78 00
1566	Allen Aldrich, " " &c.,	79 10
1567	E. M. Hunt, cement,	224 94
1568	Moulton & Remington, repairing hose cart,	24 30
1569	Robert Morrow, horse hire by engineers,	144 00
1570	Providence and Stonington Steamship Co., freight of sewer pipes,	62 50
1571	Wightman & Liscomb, oil and oatmeal,	5 98
1572	Bernard Swift, building lamp-holes, sewer in Dawson, Brighton and Knight streets,	6 00
1573	Leach & Co., extra labor, sewer in Borden street,	34 64
1574	Lobdell & Newmans, labor and materials, Brown street sewer,	1,465 96
1575	Rhode Island Concrete Co., concreting around catch basins, &c.,	80 85
1576	Willard F. Inman, on account for constructing sewer in High, Knight, Washington and Battery streets,	2,325 00
1577	Alfred Mundell, on account for constructing sewer in Pond street, from Summer street to Fenner street,	425 00
1578	Leach & Co., on account for constructing sewer in Arnold street, from East street to Governor street,	75 00
1579	W. A. Burdick, Agent, catch-basin stones,	414 00
1580	Wood & Winsor, syphon, pipe, &c.,	16 86
1581	Charles H. Pierce, paying laborers, &c.,	1,262 19
1582	" " " " " "	420 30
1583	" " " on account for paying laborers,	200 00
1584	George B. Inman, constructing sewer in George street, from Cooke street to Brook street,	268 41
1585	George B. Inman, constructing sewer in Lemon street,	57 66
1586	" " " " " High, Courtland, Carpenter and Fountain streets,	1,849 19
1587	Fuller Iron Works, iron sewer castings,	321 85
1588	Leach & Co., constructing sewer in Arnold street, from East street to Governor street,	225 01
1589	Hopkins & Pomroy, brick, cement, cartage, &c.,	1,409 52
1590	J. W. & J. J. Newman, extra labor, sewer in Olney street,	11 61
1591	Henry W. Ellis, repairing tools, &c.,	12 90
1592	Barker, Whitaker & Co., tools, &c.,	42 48
1593	Wm. H. Miller & Co., dressing stone tools, &c.,	15 55
1594	Providence & Stonington Steamship Co., freight of sewer pipe, (charged to R. G. Walmsley,)	17 67
1595	Haight & Southard, bricks,	466 00
1596	Daniel J. Haight, " "	471 00
1597	Providence Builders' Association, bricks, &c.,	371 36
1598	William Nelson, Jr., sewer pipes, &c.,	319 53
	Amount carried forward,	\$42,522 49

	Amount brought forward,	\$42,522 49
1599	Akron Sewer Pipe Co., " " "	1,061 36
1600	G. W. Rader & Co., " " "	640 35
1601	Hammond, Angell & Co., printing,	120 50
1602	Charles H. Pierce, paid by him for sundries,	19 75
1603	" " " " " "	6 30
1604	Hopkins & Pomroy, cement and cartage,	15 25
1605	H. M. Angell & Co., lumber, &c.,	59 17
1606	Wm. H. Miller & Co., repairing tools, &c.,	8 85
1607	Barker, Whitaker & Co., rope, tools, &c.,	26 30
1608	Hammond, Angell & Co., printing,	8 19
1609	Providence Water Works, salaries, office expenses, &c.,	225 78
1610	Charles H. Pierce, paying laborers, &c.,	384 23
1611	" " " " " "	980 47
1612	" " " on account for paying laborers, &c.,	200 00
1613	Lobdell & Newmans, labor and materials,	2,598 40
1614	Schooner Harvest, freight of sewer materials, (charged to G. W. Rader & Co.,)	107 50
1615	Patrick Smith, constructing sewer in Bridgham street, from Cranston street to Central street,	551 49
1616	Patrick Smith, constructing sewer in Beacon and Maple streets,	77 68
1617	Patrick Smith, constructing sewer in Courtland street,	751 79
1618	Willard F. Inman, constructing sewer in High, Knight, Washington and Battey streets,	610 62
1619	W. A. Burdick, Agent, catch-basin stones,	1,178 34
1620	Lucius J. Sampson, salary as engineer of private drains,	100 00
1621	Rencellear B. S. Hart, " " inspector " " "	80 00
1622	E. M. Hunt, cement,	913 56
1623	Robert Morrow, horse hire, &c., by engineers,	150 00
1624	Lucius J. Sampson, horse hire,	78 00
1625	Bernard Swift, reservation, sewer in Transit street, from Mohawk alley to Benefit street,	10 00
1626	H. B. Leach & Sons, reservation, sewer in Thayer, Angell and Brook streets,	1,827 67
1627	Akron Sewer Pipe Association, on account for freight of sewer pipes, (charged to Akron Sewer Pipe Association,)	500 00
1628	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
1629	Allen Aldrich, horse hire,	54 00
1630	H. M. Angell & Co., lumber,	9 16
1631	Stanton Clark, Agent, catch-basin stones,	217 00
1632	Leach & Co., on account for constructing sewer in Thayer street, from George street to Charles Field street,	975 00
1633	Bernard Swift, on account for constructing sewer in Olive street,	1,250 00
1634	J. W. & J. J. Newman, constructing sewer in Olney street, from Mallett street to North Main street,	1,376 41
1635	J. W. & J. J. Newman, constructing sewer in Eddy street, from Broad street to Pine street,	220 80
	Amount carred forward,	\$60,016 41

REPORT ON SEWERS.

15

	Amount brought forward,	\$60,016 41
1636	C. Frank Allen, salary as inspector of sewer pipes,	100 00
1637	Thomas R. Belcher, " " " on sewers,	100 00
1638	William Whittaker, " " " " "	100 00
1639	Duty J. Greene, " " " " "	104 00
1640	Henry L. Ripley, " " " " "	120 00
1641	William Bowler, " " " " "	104 00
1642	William H. Smith, " " " " "	104 00
1643	Henry F. Davis, " " " " "	88 00
1644	James L. Sherman, " " " " "	91 00
1645	Alfred E. Martin, " " " " "	10 50
1646	William H. Kelley, testing cement,	58 50
1647	Leach & Co., on account for constructing sewer in Arnold street, from Brook street westerly to its summit,	900 00
1648	J. W. & J. J. Newman, on account for constructing sewer in North Main, Hewes and Stevens streets,	450 00
1649	Patrick Smith, on account for constructing sewer in Pearl street, from Oranston to Central street,	1,750 00
1650	Alfred Mundell, on account for constructing sewer in Pond, Summer and Broad streets,	2,025 00
1651	Willard F. Inman, on account for constructing sewer in Greenwich, Burnett and Public streets,	325 00
1652	Smith Granite Co., catch-basin stones,	464 00
1653	Willard F. Inman, constructing sewer in Benefit street, from Angell street to College street,	1,531 30
1654	Charles H. Pierce, paying laborers, &c.,	1,188 82
1655	" " " " "	479 80
1656	" " " on account for paying laborers,	200 00
1657	Schooner Phil. Sheridan, freight of sewer materials, (charged to Akron Sewer Pipe Association,)	216 50
1658	Charles H. George, freight and insurance of sewer materials, (charged to Akron Sewer Pipe Association,)	77 01
1659	Schooner George F. Brown, freight of sewer materials, (charged to Akron Sewer Pipe Association,)	23 60
1660	Schooner Artist, freight of sewer materials, (charge to R. G. Walmsley,)	129 10
1661	Hopkins & Pomroy, brick, cement, cartage, &c.,	3,130 25
1662	Albert Dalley & Co., lumber and cartage,	157 16
1663	William H. Miller & Co., repairing tools, &c.,	16 74
1664	Barker, Whitaker & Co., tools, &c.,	11 18
1665	Fuller Iron Works, iron sewer castings,	157 20
1666	A. Waite, teaming,	17 80
1667	Amos M. Hawkins & Co., mortar beds, &c.,	10 44
1668	George W. Hall & Co., sewer pipe,	21 60
1669	Willard F. Inman, constructing sewer in Greenwich, Burnett and Public streets,	604 10
1670	Willard F. Inman, extra labor, sewer in Greenwich, Burnett and Public streets,	22 02
1671	Leach & Co., constructing sewer in Arnold street, from Brook street westerly to summit,	98 49
	Amount carried forward,	\$75,003 50

	Amount brought forward,	\$75,003 50
1672	A. A. Mundell, oil,	5 61
1673	John O'Donnell & Co., reservation, sewer in Middle street,	20 00
1674	George W. Hall & Co., cement,	6 00
1675	Barker, Whitaker & Co., tools, &c.,	7 64
1676	Wood & Winsor, pulley, labor, &c.,	8 39
1677	William H. Miller & Co., repairing tools, &c.,	9 34
1678	Providence Builders' Association, sewer pipes,	119 44
1679	R. G. Walmsley, sewer pipes,	1,071 44
1680	Charles H. Pierce, paid by him for sundries,	20 33
1681	Bernard Swift, contract reservation, sewer in Chapel and Snow streets,	42 55
1682	Gilmore & Judge, constructing sewer in Vinton street, from Vernon street to Carpenter street,	258 40
1683	Schooner Panthea, freight of sewer pipes, (charged to Wm. Nelson, Jr.),	26 00
1684	Patrick Powers, constructing catch-basin chutes, sewer in Orms and Charles street,	45 15
1685	Charles H. Pierce, paying laborers, &c.,	2,696 90
1686	Charles H. Pierce, on account for paying laborers, &c.,	300 00
1687	Charles H. Pierce, paying laborers, &c.,	534 57
1688	Lobdell & Newmans, labor and materials, Brown street sewer,	1,579 12
1689	James McLaughlin, repairing tools, sewer in Orms and Charles streets,	8 20
1690	Stanton Clark, Agent, catch-basin stones,	34 68
1691	Providence and Stonington Steamship Co., freight of sewer materials, (charged to Akron Sewer Pipe Association,)	699 30
		<hr/> \$82,496 56

TRIAL BALANCE OF BOARD OF WATER COMMISSIONERS'
LEDGER, SEWER DEPARTMENT, NOVEMBER 30, 1875.

Dr.

Books, stationery, &c.,	\$43 55
Traveling expenses of commissioners,	51 62
Building on Cove lands,	129 15
Stones from Brook street sewer,	2,123 31
Carting stones from sewers to Cove lands,	1,932 62
Shed for storing materials,	132 13
Tools,	5,112 85
Centres, forms, templets, &c.,	203 50
Printing,	2,546 34
Sundries,	112 23
Testing cement,	2,037 18
Inspection of connections,	4,311 19
Inspection of sewer pipe,	1,109 58
Sewer pipes, rings, covers, &c.,	14,229 03
Bricks,	11,116 12
Catch-basin stones,	6,792 29
Catch-basin covers,	794 69
Catch-basin traps,	568 45
Manhole frames and covers,	3,086 05
Manhole stones,	184 67
Lamphole frames and covers,	182 13
Invert blocks,	2,196 00
Iron sewer connections,	75 30
Iron rods,	35 02
Sheet piling,	661 04
Sewer pipe experiments,	75 80
Supplying water for sewer work,	1,171 17
Superintendence of cleaning and repairs,	2,491 55
Cleaning catch-basins and sewers,	13,721 33
Cleaning and repairing old sewers,	6,602 97
Repairing new sewers,	3,071 84
Salaries and office expenses,	15,250 43
City Treasurer,	4,637 67
Additional catch-basins,	859 76
Additional work on sewers,	1,124 00
Alterations caused by change of grades,	917 15
Catch-basins in Exchange street and Exchange Place,	511 89
Catch-basins in Hope street,	869 57
Catch-basin in Park street,	114 60
Catch-basin in Benefit street near Thomas street,	101 79
Catch-basin corner of Eddy and Ship streets,	108 01
Catch-basin corner of Hopkins and South Main streets,	76 26

Amount carried forward, \$111,471 83

	Amount brought forward,	\$111,471 83
Sewer in	Thayer, Angell and Brook streets,	83,032 87
" "	Transit street, from Mohawk alley to Benefit street,	481 31
" "	High, Courtland, Carpenter and Fountain streets,	33,822 84
" "	Middle street, from Eddy street to Dorrance street,	735 74
" "	Benevolent and Benefit streets,	6,483 63
" "	South Water street, from College to Crawford street,	2,045 10
" "	Chapel and Snow streets,	1,933 07
" "	Bridgham, Central and Pearl streets,	9,093 63
" "	Prairie avenue, from Public to Pearl street,	12,212 73
" "	South street, from Plane to Richmond street,	5,623 40
" "	Keene street, from Prospect to Thayer street,	4,887 57
" "	Dyer street, from Market square to Orange street,	6,998 70
" "	Pine street, from near Seekell to Pearl street,	5,127 48
" "	Newton street, from near Federal street to Atwell's avenue,	486 49
" "	Richmond street, from Elm to Point street,	1,727 40
" "	Sutton street, from near Asia street to Broadway,	2,672 13
" "	Langley street, from Plane to Hospital street,	3,519 54
" "	College street, from Benefit to Prospect street,	2,271 44
" "	Lemon street, from Carpenter to Fountain street,	986 34
" "	Beacon street, from Broad to Pine street,	919 66
" "	Crary street, from Plane to Mary street,	1,313 77
" "	Hospital street, from Crary to Borden street,	309 31
" "	Dawson, Brighton and Knight streets,	4,686 61
" "	Arnold street, from Benefit street, easterly to its summit,	616 79
" "	Prairie avenue and Prince street,	4,284 42
" "	Olney street, from Mallett to North Main street,	10,597 51
" "	Carpenter and Battey streets,	3,715 56
" "	Beacon and Maple streets,	5,270 31
" "	Knight street, from Carpenter to Washington street,	850 96
" "	High, Knight, Washington and Battey streets,	6,640 72
" "	George street, from Cooke to Brook street,	2,889 18
" "	Borden street, from Plane to Eddy street,	2,150 01
" "	Clemence street, from Washington to Fountain street,	781 12
" "	Vinton street, from Asia street to Broadway,	1,897 84
" "	Knight street, from High street, southerly to its summit,	1,125 81
" "	High street, from Battey to Knight street,	1,672 23
" "	Courtland street, from Carpenter street to Broadway,	1,902 51
	Amount carried forward,	\$346,637 56

REPORT ON SEWERS.

19

Amount brought forward,	346,637 56
" " Bridgham street, from Cranston street to Central street,	4,491 72
" " Brown street, from Barnes to Olney street,	6,019 45
" " Amos street, from North Main to Canal street,	609 43
" " Arnold street, from East to Governor street,	409 42
" " Custom House street, from Weybosset to Dyer street,	472 95
" " Pond street, from Summer to Fenner street,	250 17
" " Orms and Charles streets,	4,220 60
" " Benefit street, from Angell to College street,	1,895 50
" " Thayer street, from George to Charles Field street,	287 81
" " Arnold street, from Brook street westerly to its summit,	1,244 63
" " Pond, Summer and Broad streets,	461 82
" " Pearl street, from Cranston to Central street,	420 48
" " Olive street, from near Prospect to Thayer street,	177 47
" " Eddy street, from Broad to Pine street,	281 89
" " North Main, Hewes and Stevens streets,	163 34
" " Vinton street, from Vernon to Carpenter street,	310 68
" " Greenwich, Burnett and Public streets,	1,105 42
" " Broad, Somerset and Pine streets,	20 37
" " Ship and Dyer streets,	4 80
" " Plane and Blackstone streets,	268 74
" " Lippitt street, from Camp to North Main street,	9 15
" " Federal street, from Bradford street to Broadway,	7 22
" " Atwell's avenue, from Acorn to Dean street,	3 09
Washington street sewer outlet,	99 40
North Main street sewer overflow,	377 32
Alfred Mundell, for Pond street from Summer to Fenner street,	425 00
Alfred Mundell, for Pond, summer and Broad streets,	2,031 25
Leach & Co., for Thayer street, from George to Charles Field street,	975 00
Patrick Smith, for Pearl street, from Cranston to Central street,	1,750 00
Patrick Smith, for Broad, Somerset and Pine streets,	4 95
Bernard Swift, for Olive street, from near Prospect to Thayer street,	1,250 00
J. W. and J. J. Newman, for North Main, Hewes and Stevens streets,	453 00
J. W. and J. J. Newman, for South Water street, from College to Crawford street,	6 97
G. W. Rader & Co.,	107 50
City of Providence, highway department,	777 13
William H. Bowen,	44 98
John Gillen,	15 30
William Nelson, Jr.,	31 40
R. G. Walmsley,	129 10
Amount carried forward,	\$378,257 57

Amount brought forward,	\$378,257 57
Charles H. Pierce,	300 00
Akron Sewer Pipe Association,	1,516 41
Completed sewers,	385,673 71
Engineering department, for horse hire,	2,624 85
Engineering department, for books, stationery, &c.,	35 49
" " " sundries,	528 20
" " " printing,	517 97
" " " advertising,	32 37
" " " labor,	681 97
" " " instruments,	188 69
" " " brick arch experiments,	72 95
	<hr/> \$770,430 18

CR.

George B. Inman, for High, Courtland, Carpenter and Fountain streets,	\$838 23
" " " " Lemon street, from Carpenter to Fountain street,	25 00
" " " " Beacon street, from Broad to Pine street,	14 50
" " " " Arnold street, from Benefit street easterly to its summit,	15 00
" " " " George street, from Cooke to Brook street,	65 00
Alfred Mundell, for Benevolent and Benefit streets,	78 35
" " " " Dyer street, from Market square to Orange street,	167 25
" " " " Richmond street, from Elm to Point street,	43 35
" " " " Clemence street, from Washington to Fountain street,	18 80
Patrick Smith, for Bridgham, Central and Pearl streets,	235 00
" " " " Keene street, from Prospect to Thayer street,	121 00
" " " " Sutton street, from near Asia street to Broadway,	40 15
" " " " Beacon and Maple streets,	100 00
" " " " Vinton street, from Asia street to Broadway,	30 00
" " " " Courtland street, from Carpenter street to Broadway,	40 00
" " " " Bridgham street, from Cranston street to Central street,	100 00
Gilmore & Judge, for Prairie avenue, from Public to Pearl street,	360 72
" " " " Carpenter and Battey streets,	76 63
" " " " Vinton street, from Vernon to Carpenter street,	8 25
Amount carried forward,	<hr/> \$2,877 23

REPORT ON SEWERS.

21

Amount brought forward, . . .	\$2,377 23
Willard F. Inman, for Pine street, from near Seekell street to Pearl street, . . .	94 19
" " " " Crary street, from Plane to Mary street, . . .	35 00
" " " " High, Knight, Washington and Battey streets, . . .	270 00
" " " " Benefit street, from Angell to College street, . . .	73 93
" " " " Greenwich, Burnett and Public streets, . . .	50 00
Bernard Swift, for Newton street, from near Federal street to Atwell's avenue, . . .	10 00
" " " Knight street, from Brighton to Carpenter street, . . .	35 00
" " " Knight street, from Carpenter to Washington street, . . .	15 00
" " " Knight street, from High street southerly to its summit, . . .	25 00
" " " High street, from Battey to Knight street, . . .	23 73
John O'Donnell, for Langley street, from Plane to Hospital street, . . .	53 28
J. W. & J. J. Newman, for College street, from Benefit to Prospect street, . . .	47 85
J. W. & J. J. Newman, for Olney street, from Mallett to North Main street, . . .	370 00
J. W. & J. J. Newman, for Eddy street, from Broad to Pine street, . . .	10 00
Leach & Co., for Borden street, from Plane to Eddy street, . . .	85 00
" " " " Arnold street, from East to Governor street, . . .	15 00
" " " " Arnold street, from Brook street, westerly, to its summit, . . .	46 20
Smith Granite Co., . . .	95 75
Approved bills, . . .	766,699 02
	<hr/> \$770,430 19

**TRIAL BALANCE OF LEDGER, COMMITTEES APPOINTED BY THE
BOARD OF ALDERMEN, TO CONSTRUCT CERTAIN SEWERS,
NOVEMBER 30, 1875.**

Dr.

Dorrance street, from Westminster to Broad street, etc.,	\$10,424	36
Dorrance street, from Westminster street to the river,	13,206	82
Thomas Pearson, for Dorrance street, from Westminster street to the river,	-	18,970 15
Approved bills,	-	338,654 55
		<u>\$381,255 88</u>

Cr.

Thomas Newman, for Pearl street, from Broad to Mumford street,	-	1,590 36
Approved bills,	-	379,665 52
		<u>\$381,255 88</u>

**RECEIVED BY THE BOARD OF WATER COMMISSIONERS, SEWER
DEPARTMENT, FROM SEPTEMBER 1, 1875, TO NOVEMBER 30, 1875,
INCLUSIVE, AND PAID TO THE CITY TREASURER :**

1875.

September 1.	Of Thomas Phillips & Co., for labor and materials,	114 55
14.	Of William M. Bailey, Trustee, for labor and materials,	78 50
	Of Union Railroad Company, for labor and materials,	20 55
	Of John Bligh, for labor, cleaning private connection,	5 00
30.	Of John Bligh, for labor, cleaning private connection,	2 50
October 30.	Of Henry L. Ripley, for sand,	3 40
November 30.	Of David G. Hopkins, for labor, cleaning private connection,	12 40
	For labor, filling cisterns with Pawtuxet water, &c.,	23 50— \$260 40



1876.]

MASS. STATE BOARD OF HEALTH,
CITY DOCUMENTS
ENGINEER'S OFFICE.
[No. 17.]

EIGHTH REPORT.

OF THE BOARD OF

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE.

[Elected February 27, 1874.]

ON

SEWERS,

MARCH 1, 1876.



PROVIDENCE:

PROVIDENCE PRESS COMPANY, PRINTERS TO THE CITY.

1876.

1876.]

CITY DOCUMENT.

[No. 17.]

EIGHTH REPORT
OF THE BOARD OF
WATER COMMISSIONERS
OF THE
CITY OF PROVIDENCE.

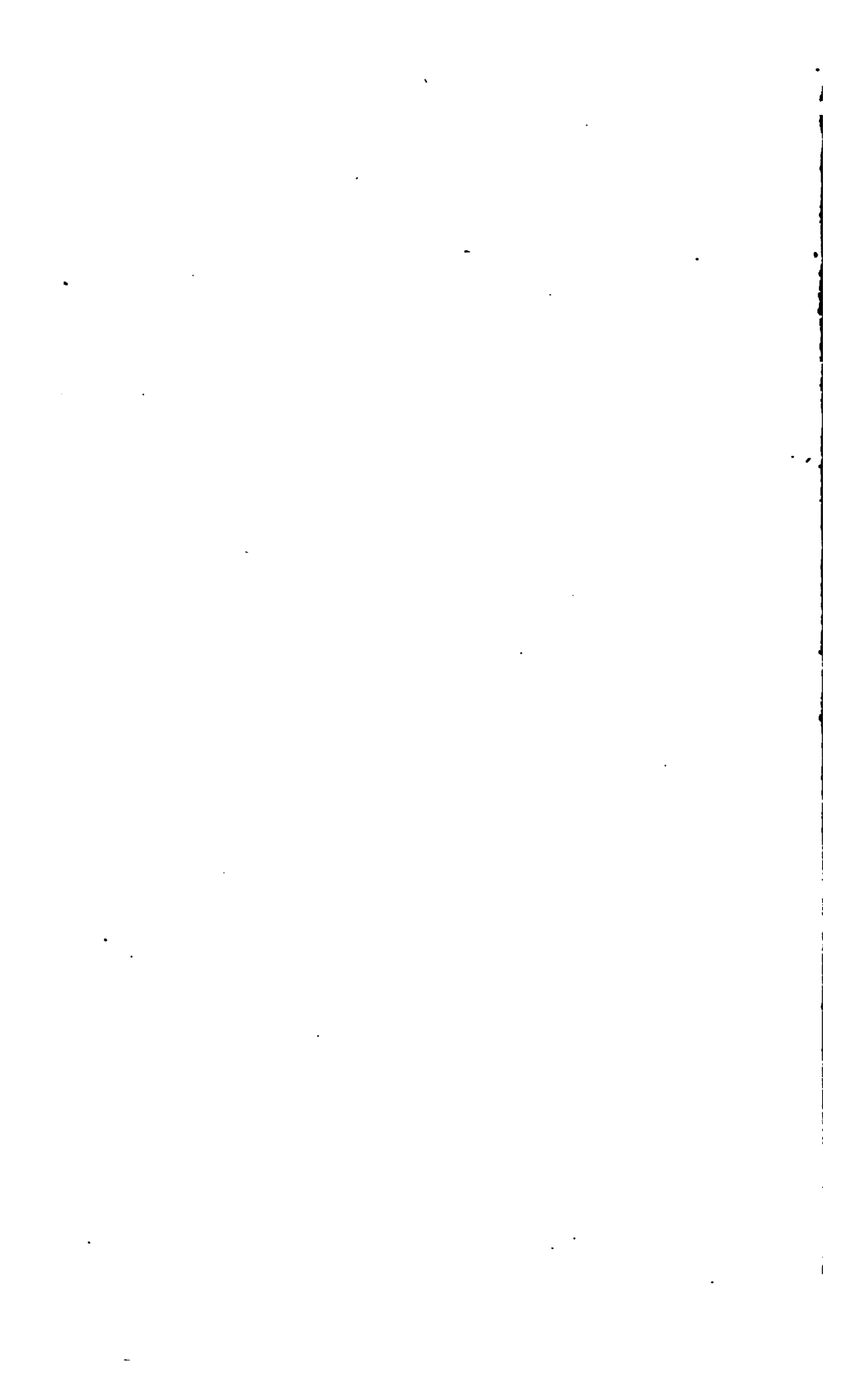
[Elected February 27, 1874.]

ON
SEWERS,

MARCH 1, 1876.



PROVIDENCE:
PROVIDENCE PRESS COMPANY, PRINTERS TO THE CITY.
1876.



ORGANIZATION
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT.

CHARLES E. CARPENTER,

WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.

Office No. 35 North Main Street.

CHIEF ENGINEER.

J. HERBERT SHEDD.

Office No. 35 North Main Street.

REPORT.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
PROVIDENCE, March 1st, 1876. }

TO THE HONORABLE THE CITY COUNCIL:

The Board of Water Commissioners, elected February 27th, 1874, respectfully present their Eighth Quarterly Report on Sewers.

A full report has been made to the Board of Aldermen upon the following named sewer, built by the Water Commissioners, as a committee constituted by the Board of Aldermen, to cause its construction:

Dorrance street, from Westminster street to the river; ordered November 25, 1872; report dated January 26, 1876; cost \$51,660.27.

Since the date of the last report sewers have been ordered by the City Council as follows:

Across High street and through the land now belonging to Alfred Anthony and Samuel A. Irons, from the southerly side of High street near the Johnston line, at or near the place where the stone culvert is now, to the Woonasquatucket river.

Pearl street, from the Pearl street sewer at Beacon street to Plane street.

Pine street, from Dyer street to Hay street.

The following sewers have been completed since the date of the last report :

Broad, Somerset and Pine streets, from Bridgham street to Pearl street.

Eagle street, from Atwell's avenue to the Woonasquatucket river.

Pine street, from Dyer street to Hay street.

Thayer street, from Waterman street to George street.

The following sewer has been completed, with the exception of six catch-basins, which are not to be built until the street is graded and curbed :

Olive street, from the summit between Prospect and Thayer streets to Thayer street.

The accounts in relation to the following completed sewers are not yet in readiness for a statement of their cost :

Borden street, from Hospital street to Eddy street.

Crary street, from Plane street to Mary street.

Federal street, from Bradford street to Broadway.

Pine street, from Dyer street to Hay street.

The following sewers ordered by the City Council, are in a state of progress, as follows :

Atwell's avenue, from Acorn street to Dean street ; one man-hole and one hundred and twenty-two feet of sewer built in December, 1875, when work was suspended until spring.

Borden street, from Plane street to Hospital street ; completed except four catch basins.

Lippitt street, from Camp street to North Main street ; completed except six catch-basins.

Pearl street, from the Pearl street sewer at Beacon street to Plane street ; work commenced 28th ultimo.

Plane and Blackstone streets, from Dudley street to tide-water ; completed except five catch-basins.

Work on the following sewers, (completing the list ordered to be constructed by the Board of Water Commissioners,) has not been commenced :

Friendship, West Friendship, and Dudley streets, from Greenwich street to Plane street.

Pond street, from the summit between Spring and Winter streets to Pearl street.

Ship and Dyer streets, from Richmond street to Dorrance street.

Tower street, from Atwell's avenue to Federal street:

The accounts in relation to the following completed sewers have been made up, and the cost of each is as follows :

<i>Amos street, from North Main street to the river,</i>	<i>\$1,036 60</i>
<i>Arnold street, from Benefit street easterly to summit between Benefit street and Thayer street,</i>	<i>695 78</i>
<i>Arnold street, from the summit between Benefit and Thayer streets to Brook street,</i>	<i>2,436 04</i>
<i>Arnold street, from East street to Governor street,</i>	<i>790 12</i>
<i>Beacon street, from Pine street to Broad street,</i>	<i>1,034 40</i>
<i>Beacon and Maple streets, from Prince street to Pearl street,</i>	<i>5,910 92</i>
<i>Benefit street, from Angell street to College street,</i>	<i>2,627 69</i>
<i>Benevolent and Benefit streets, from Brown street to College street,</i>	<i>7,285 47</i>
<i>Bridgham street, from Cranston street to Central street,</i>	<i>5,286 16</i>
<i>Bridgham, Central and Pearl streets, from summit in Bridgham street, east of Central street, to Broad street,</i>	<i>10,222 58</i>
<i>Broad, Somerset and Pine streets, from Bridgham street to Pearl street,</i>	<i>9,023 50</i>
<i>Brown street, from Barnes street to Olney street,</i>	<i>8,762 44</i>
<i>Carpenter street, from Fountain street to Batley street,</i>	<i>1,180 32</i>

<i>Carpenter and Batley streets, from Ringgold street to Fountain street,</i>	\$4,179 14
<i>Clemence street, from Washington street to Fountain street,</i>	881 47
<i>Chapel and Snow streets, from Burrill street to Westminster street,</i>	2,169 03
<i>College street, from Benefit street to Prospect street,</i>	2,554 23
<i>Courtland street, from Carpenter street to Broadway,</i>	2,237 99
<i>Custom House street, from Weybosset street to Dyer street,</i>	919 34
<i>Dawson, Brighton and Knight streets, from Marshall street to Carpenter street,</i>	5,907 22
<i>Dyer street, from Market square to Orange street,</i>	7,900 16
<i>*Eagle street, from Atwell's avenue to the Woonasquatucket river,</i>	2,004 80
<i>Eddy street from Broad street to Pine street,</i>	572 12
<i>George street, from Cooke street to Brook street,</i>	3,249 01
<i>*Greenwich, Burnett and Public streets, from Daboll street to the low point on Public street, between Burnett and Austin streets,</i>	1,739 78
<i>High street, from Batley street to Knight street,</i>	1,763 10
<i>High, Courtland, Carpenter and Fountain streets, from Almy street to Jackson street,</i>	37,913 32
<i>High, Knight, Washington and Batley streets, from Courtland street to Fountain street,</i>	11,891 71
<i>Hospital street, from Crary street to Borden street,</i>	385 07
<i>Keene street, from Prospect street to Thayer street,</i>	5,764 30
<i>Knight street, from Carpenter street to Washington street,</i>	958 33
<i>Knight street, from the summit between Cranston and High streets to High street,</i>	1,263 03
<i>Lane nearly opposite Star street, from North Main street to the Moshassuck river,</i>	839 20
<i>Langley street, from Plane street to Hospital street,</i>	4,068 30

<i>Lemon street, from Carpenter street to Fountain street,</i>	<i>\$1,111 40</i>
<i>Middle street, from Eddy street to Dorrance street,</i>	<i>827 17</i>
<i>Newton street, from summit between Atwell's avenue and Federal street to Atwell's avenue,</i>	<i>549 12</i>
<i>North Main, Hewes and Stevens streets, from Olney street to the Moshassuck river,</i>	<i>7,371 13</i>
<i>Olive street, from the summit between Prospect and Thayer streets to Thayer street,</i>	<i>5,569 52</i>
<i>Olney street, from Mallett street to North Main street,</i>	<i>12,114 05</i>
<i>Orms and Charles streets, from the railroad bridge on Orms street to Mill street,</i>	<i>7,860 66</i>
<i>Pearl street, from Cranston street to Central street,</i>	<i>4,963 36</i>
<i>Peck street, from Weybosset street to Dyer street,</i>	<i>1,467 41</i>
<i>Pine street, from summit near Seekel street to Pearl street,</i>	<i>5,771 33</i>
<i>Pond street, from Summer street to Fenner street,</i>	<i>3,313 56</i>
<i>Pond street, from summit between Spring and Winter streets, through Summer and Broad streets to Pearl street,</i>	<i>8,093 40</i>
<i>Prairie avenue, from Public street to Pearl street,</i>	<i>13,786 24</i>
<i>Prairie avenue and Prince street, from Friendship street to Pearl street,</i>	<i>5,464 58</i>
<i>Richmond street, from Elm street to Point street,</i>	<i>1,945 58</i>
<i>South street, from Plane to Chestnut street and from Chestnut to Richmond street,</i>	<i>6,995 33</i>
<i>South Water street, from College street to the river at foot of Crawford street,</i>	<i>2,562 49</i>
<i>Sutton street, from summit between Asia and Lee streets to Broadway,</i>	<i>3,006 36</i>
<i>Thayer street, from George street to Charles Field street,</i>	<i>4,014 07</i>
<i>Thayer street, from Waterman street to George street,</i>	<i>3,480 08</i>

<i>Thayer street, from Bowen street to Angell street, and through Angell and Brook streets to the river,</i>	<i>\$93,513 18</i>
<i>Transit street, from Mohawk alley to Benefit street,</i>	<i>539 74</i>
<i>Vinton street from Asia street to Broadway,</i>	<i>1,636 04</i>
<i>Vinton street, from Vernon street to Carpenter street,</i>	<i>685 47</i>
	<hr/> <i>\$352,093 94</i>

* Built for surface drainage only, and the expense charged to the appropriation for highways, by order of the City Council.

During the last quarter the Commissioners, as a committee constituted by the Board of Aldermen, acting under the advice of the City Solicitor, have approved a bill of Thomas Pearson against the city, amounting to fifteen hundred and ninety $\frac{90}{100}$ dollars, for extra work and materials (including interest) in the construction of the sewer ordered to be built "from Atwell's avenue, through Bourn street, Broadway, Carpenter, Jackson, High, Chestnut, and Elm streets, to the river," and reported upon by said committee, Feb. 24, 1874. This has increased the cost of said sewer to, *\$87,547 35*

Assessments for the following sewers have been completed and certified to the City Treasurer :

<i>Amos street, from North Main street to the river,</i>	<i>\$267 29</i>
<i>Arnold street, from the summit between Benefit and Thayer streets to Brook street,</i>	<i>1,574 48</i>
<i>Arnold street, from East street to Governor street,</i>	<i>706 46</i>
<i>Benefit street, from Angell street to College street,</i>	<i>823 74</i>
<i>Bridgham street, from Cranston street to Central street,</i>	<i>2,992 38</i>
<i>Broad, Somerset and Pine streets, from Bridgham street to Pearl street,</i>	<i>3,499 21</i>
<i>Brown street, from Barnes street to Olney street,</i>	<i>3,445 73</i>
<i>Carpenter street, from Fountain street to Battey street,</i>	<i>1,181 52</i>

<i>Courtland street, from Carpenter street to Broadway,</i>	\$1,677 83
<i>Custom House street, from Weybosset street to Dyer street,</i>	464 16
<i>Dawson, Brighton and Knight streets, from Marshall street to Carpenter streets,</i>	3,440 79
<i>Eddy street, from Broad street to Pine street,</i>	352 53
<i>Federal street, from Bradford street to Broadway,</i>	1,271 99
<i>High street, from Batley street to Knight street,</i>	1,175 02
<i>High, Knight, Washington and Batley streets, from Courtland street to Fountain street,</i>	6,683 88
<i>Knight street, from Carpenter street to Washington street,</i>	370 07
<i>Knight street, from the summit between Cranston and High streets to High street,</i>	687 07
<i>Lippitt street, from Camp street to North Main street,</i>	4,151 61
<i>North Main, Hewes and Stevens streets, from Olney street to Moshassuck river,</i>	3,412 71
<i>Olive street, from the summit between Prospect and Thayer streets to Thayer street,</i>	2,271 44
<i>Olney street, from Mallett street to North Main street,</i>	4,956 15
<i>Pearl street, from Cranston street to Central street,</i>	2,286 46
<i>Peck street, from Weybosset street to Dyer street,</i>	980 04
<i>Pond street, from Summer street to Fenner street,</i>	3,224 60
<i>Pond street, from summit between Spring and Winter streets, through Summer and Broad streets to Pearl street,</i>	4,726 39
<i>Thayer street, from George street to Charles Field street,</i>	1,341 68
<i>Thayer street, from Waterman street to George street,</i>	1,943 28
<i>Vinton street, from Vernon street to Carpenter street,</i>	441 32
	<hr/>
	\$60,349 83

The cost of sewers constructed under Chapter 807 of the Public Laws, and Chapter 313 of the General Statutes, as far as reported, for which assessments have been made, is . . . \$1,131,892 64

The *approximate* cost of the following sewers, is

Borden street from Plane street to Hospital street, and from Hospital street to Eddy street, \$4,206 20

Crary street from Plane street to Mary street, 1,751 71

Federal street, from Bradford street to Broadway, . 3,252 58

Lippitt street, from Olney street to North

Main street, 10,272 49 19,482 98

\$1,151,375 62

The amount of assessments for such sewers, certified to the City Treasurer is 441,976 80

A Drain-Layer's license has been issued to David S. Anthony; the total number of such licenses issued to date is sixty.

A schedule of sewer bills approved by the Board of Water Commissioners, from December 1, 1875, to February 29, 1876, inclusive; a trial balance of the Board of Water Commissioners' Ledger, Sewer Department, February 29, 1876, inclusive, a trial balance of the Ledger of the Committees

appointed by the Board of Aldermen to build certain sewers February 29, 1876, inclusive, and a schedule of receipts by the Board of Water Commissioners, paid to the City Treasurer from December 1, 1875, to February 29, 1876, inclusive, are hereunto appended, and made parts of this report.

JOSEPH J. COOKE,	}	<i>Board of Water Commissioners.</i>
CHAS. E. CARPENTER,		
WILLIAM CORLISS,		

SCHEDULE OF BILLS APPROVED BY THE BOARD OF WATER COMMISSIONERS, SEWER DEPARTMENT, FROM DECEMBER 1, 1875, TO FEBRUARY 23, 1876, INCLUSIVE.

1692	Lucius J. Sampson, salary as engineer of private drains,	100 00
1693	Rencellaer B. S. Hart, " " inspector of private drains,	80 00
1694	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
1695	Duty J. Greene, " " inspector,	104 00
1696	Henry L. Ripley, salary as inspector on sewers,	120 00
1697	William Whittaker, " " " " " "	100 00
1698	Thomas R. Belcher, " " " " " "	100 00
1699	Henry F. Davis, " " " " " "	104 00
1700	William Bowler, " " " " " "	95 00
1701	William H. Smith, " " " " " "	102 00
1702	Alfred E. Martin, " " " " " "	91 00
1703	James L. Sherman, " " " " " "	85 75
1704	William H. Kelly, testing cement,	58 72
1705	Leach & Co., on account for constructing sewer in carpenter street,	425 00
1706	George E. Leach, on account for constructing sewer in Thayer street, from Waterman to George street,	975 00
1707	Bernard Swift, on account for constructing sewer in Olive street,	1,300 00
1708	Alfred Mundell, " " " " " Eagle street,	650 00
1709	James J. Newman, on account for constructing sewer in Federal street,	1,050 00
1710	Willard F. Inman, on account for constructing sewer in Lippitt street,	1,550 00
1711	Akron Sewer Pipe Association, sewer pipe,	2,842 17
1712	A. C. Eddy & Studleys, rubber boots, &c.,	65 10
1713	Willard F. Inman, extra labor. sewer in High, Courtland, Carpenter and Fountain streets,	10 06
1714	Gilmore & Judge, overtime deducted in bill for constructing sewer in Prairie avenue,	50 00
1715	Lucius J. Sampson, horse hire,	78 00
1716	Alfred Mundell, contract reservation, sewer in Benevolent and Benefit streets,	78 35
1717	Smith Granite Co., catch-basin stones,	275 00
1718	Alfred Mundell, constructing sewer in Pond street, from Summer to Fenner street,	770 23
1719	Allen Aldrich, horse hire, &c.,	73 15
1720	A. C. Eddy & Studleys, rubber boots, &c.,	23 38
1721	William H. Miller & Co., repairing hose carriage,	7 11
1722	C. Frank Allen, salary as inspector of sewer pipes,	100 00
1723	Alfred Mundell, on account for constructing sewer in Pond, Summer and Broad streets,	850 00
1724	J. W. & J. J. Newman, on account for constructing sewer in North Main, Hewes and Stevens streets,	2,475 00
1725	Leach & Co., on account for constructing sewer in Thayer street, from George to Charles Field street,	825 00
1726	Patrick Smith, on account for constructing sewer in Broad, Somerset and Pine streets,	2,125 00
1727	Patrick Smith, on account for constructing sewer in Pearl street, from Cranston to Central street,	275 00
	Amount carried forward,	\$18,114 99

REPORT ON SEWERS.

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	Amount brought forward,	\$18,114 90
1728	R. G. Walmsley, sewer pipe,	1,419 38
1729	Providence and Stonington Steamship Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association,)	618 10
1730	George Campbell, tools,	16 00
1731	Robert Morrow, horse hire by engineers,	168 00
1732	Delaney & Walsh, tools,	18 80
1733	William H. Miller & Co., repairing, tools,	20 24
1734	E. M. Hunt, cement,	162 84
1735	Fuller Iron Works, manhole covers,	22 05
1736	Providence Water Works salaries and office expenses, &c.,	1,393 94
1737	Narragansett Brick Co., bricks,	1,401 83
1738	A. Waite, teaming,	26 75
1739	Nelson Titus, supporting house on Blackstone street,	10 00
1740	Leach & Co., constructing sewer in Peck street,	541 30
1741	Charles H. Pierce, paying laborers, &c.,	1,956 42
1742	Charles H. Pierce, " " "	325 88
1743	Charles H. Pierce, on account for paying laborers, &c.,	200 00
1744	Hammond, Angell & Co., printing,	98 38
1745	W. J. Glover & Co., tarred sheathing,	27 09
1746	Alfred Mundell, contract reservation, sewer in Dyer street,	167 25
1747	Schooner Kate and Mary, freight of bricks, (charged to Haight & Southard,)	357 25
1748	Schooner E. & I. Oakley, freight of bricks, (charged to Haight & Southard,)	407 50
1749	Hopkins & Pomroy, bricks, cement, carting bricks, teaming, &c.,	4,915 41
1750	H. B. Leach & Sons, second hand lumber,	23 40
1751	Joseph Hagan, iron pots,	14 40
1752	James H. Munroe, inspecting boiler,	5 00
1753	Willard F. Inman, extra labor, sewer in Lippitt street,	38 75
1754	William Nelson, Jr., sewer pipe,	301 00
1755	Barker, Whitaker & Co., tools, &c.,	45 92
1756	Albert Dalley & Co., lumber,	557 41
1757	Allen Fire Department Supply Co., hose, couplings, &c.,	150 84
1758	Charles H. Pierce, paid by him for sundries,	20 92
1759	John Mason, tools, &c.,	34 14
1760	Henry W. Ellis, trustee, repairing tools,	23 75
1761	Bernard Swift, contract reservation, sewer in Newton street,	10 00
1762	Alfred Mundell, constructing sewer in Pond, Summer and Broad streets,	324 76
1763	Barker, Whitaker & Co., brooms, lantern globes, &c.,	5 12
1764	Charles H. Pierce, paid by him for sundries,	6 53
1765	Allen Fire Department Supply Co., tools,	7 50
1766	Providence Builders' Association, sewer pipe,	78 00
1767	Providence and Stonington Steamship Co., freight of sewer pipe,	239 10
1768	Leach & Co., on account for constructing sewer in Atwell's avenue,	100 00
1769	Alfred Mundell, constructing sewer in Eagle street,	236 55
1770	Bernard Swift, " " " Olive street,	826 40
1771	James J. Newman, " " " Federal,	107 85
1772	Willard F. Inman, on account for constructing sewer in Lippitt street,	1,000 00
1773	Alfred Mundell, contract reservation, sewer in Richmond street,	49 35
1774	T. J. Elliott, agent, sewer pails,	15 00
1775	Bernard Swift, extra labor, &c.,	12 39
1776	Charles H. Pierce, paying laborers, &c.,	1,963 81
1777	Charles H. Pierce, " " "	465 18
	Amount carried forward,	\$39,126 45

	Amount brought forward,	\$39,126 45
1778	Charles H. Pierce, on account for paying laborers, &c.,	300 00
1779	Henry L. Parsons, replacing window broken in Cheapside building,	5 50
1780	Alfred Mundell, extra labor, &c.,	49 51
1781	Lucius J. Sampson, horse hire,	78 00
1782	Mass. Portable R. R. Co., car. track couplings, &c.,	100 37
1783	Charles H. Pierce, paying laborers, &c.,	1,914 55
1784	Charles H. Pierce, " " "	342 01
1785	Charles H. Pierce, on account for paying laborers, &c.,	300 00
1786	C. Frank Allen, salary as inspector of sewer pipes,	113 50
1787	Lucius J. Sampson, " " engineer of private drains,	100 00
1788	Rencellaer B. S. Hart, " " inspector of " "	46 45
1789	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
1790	William Whittaker, salary as inspector on sewers,	115 00
1791	Thomas R. Belcher, " " " " "	100 00
1792	William Bowler, " " " " "	96 00
1793	Henry L. Ripley, " " " " "	120 00
1794	James L. Sherman, " " " " "	63 00
1795	William H. Smith, " " " " "	84 00
1796	Alfred E. Martin, " " " " "	42 00
1797	Henry F. Davis, " " " " "	21 00
1798	Duty J. Greene, " " " " "	79 50
1799	William H. Kelly, testing cement,	60 75
1800	Allen Aldrich, horse hire, &c.,	96 30
1801	Robert Morrow, " " by engineers,	123 00
1802	A. A. Mundell, oil,	7 74
1803	Hopkins & Sears, sandwiches, coffee, &c.,	9 20
1804	John McBain, carpenter's work and lumber,	9 63
1805	Nichols & Crowell, oil clothing,	9 50
1806	John H. Eddy, brooms, &c.,	6 30
1807	A. Meisel, printing plans for sewerage report,	70 00
1808	Smith Granite Co, catch-basin stones,	625 00
1809	A. A. Mundell, oil, &c.,	6 51
1810	A. Waite, teaming,	5 00
1811	Peleg S. Sherman, Jr., casks,	7 25
1812	Gilmore & Judge, contract reservation, sewer in Prairie avenue,	344 56
1813	Patrick Smith, " " " " Bridgman, Central and Pearl streets,	235 00
1814	George B. Inman, contract reservation, sewer in Lemon street,	13 80
1815	Willard F. Inman, " " " " Pine street,	94 19
1816	Willard F. Inman, " " " " Crary street,	33 25
1817	J. W. & J. J. Newman, extra labor, sewer in North Main, Hewes and Stevens streets,	348 90
1818	Willard F. Inman, on account for constructing sewer in Lippitt street,	1,075 00
1819	Patrick Smith, on account for constructing sewer in Broad, Somerset and Pine street,	1,400 00
1820	Patrick Smith, constructing sewer in Pearl street,	100 16
1821	J. W. & J. J. Newman, constructing sewer in North Main, Hewes and Stevens streets,	442 29
1822	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard,)	254 50
1823	Fuller Iron Works, iron sewer castings,	46 04
1824	B. F. Greene, assignee, lumber,	18 57
1825	Moulton & Remington, repairing hose cart,	4 95
	Amount carried forward,	\$48,685 83

REPORT ON SEWERS.

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	Amount brought forward,		\$47,685 82
1826	Providence Steam Engine Co., testing boiler,		6 60
1827	George W. Hall & Co., sewer pipe,		13 84
1828	William Nelson, Jr., " "		32 40
1829	Hammond, Angell & Co., printing,		73 15
1830	William E. Barrett & Co., tools,		81 52
1831	Willard F. Inman, extra labor, &c., sewer in Lippitt street,		69 68
1832	George W. Hall & Co., sewer pipe,		5 63
1833	Dexter Gorton & Co., lumber, labor, &c.,		258 19
1834	H. M. Angell & Co., lumber,		124 00
1835	James Haggerty, rent of house on Blackstone street,		16 50
1836	Delaney & Walsh, tools		4 75
1837	Amos M. Hawkins & Co., tools,		11 00
1838	Barker, Whitaker & Co., tools, &c.,		77 51
1839	William H. Miller & Co., repairing tools, &c.,		106 18
1840	Charles H. Pierce, paid by him for sundries,		54 44
1841	W. Congdon & Sons, paving hammers,		5 20
1842	William H. Miller & Co., tools and repairing,		13 23
1843	Barker, Whitaker & Co., tools,		20 45
1844	H. M. Angell & Co., lumber,		76 12
1845	Albert Bailey & Co., lumber, &c.,		289 90
1846	Akron Sewer Pipe Co., sewer pipes,		295 43
1847	Leach & Co., extra labor &c., on sewers,		115 26
1848	Loddell & Newmans, extra labor, sewer in Brown street,		67 05
1849	George E. Leach, extra labor, sewer in Thayer street,		20 60
1850	J. W. & J. J. Newman, contract reservation, sewer in College street,		47 40
1851	Leach & Co., constructing sewer in Thayer street,		27 98
1852	Akron Sewer Pipe Association, sewer pipes,		840 90
1853	Hopkins & Pomroy, brick, cement, carting bricks, &c.,		2,059 56
1854	William H. Fenner & Co., iron pipe, well buckets, &c.,		147 34
1855	Providence Steam and Gas Pipe Co., pipe and fittings,		5 37
1856	T. J. Elliot, agent, sewer pails,		7 50
1857	A. A. Gny & Co., carpenter's work, &c.,		10 11
1858	H. B. Leach & Sons, hoisting buckets,		25 00
1859	Willard F. Inman, extra labor, sewer in Benefit street,		19 23
1860	Narragansett Brick Co., bricks,		353 73
1861	Haight & Southard, bricks,		2,431 75
1862	Wood & Winsor, hose connection, elbow, nipples, &c.,		8 15
1863	Charles F. Pope, powder, fuse, &c.,		5 08
1864	Phenix Iron Foundry, iron sewer castings,		6 38
1865	Albert Tripp & Co., lumber, labor, &c.,		89 09
1866	Akerman & Co., blank books,		13 72
1867	G. W. Rader & Co., sewer pipe,		1,519 02
1868	George B. Inman, contract reservation, sewer in Lemon street,		13 29
1869	Leach & Co., constructing sewer in Carpenter street,		49 07
1870	Willard F. Inman, extra labor, sewer in Lippitt street,		9 72
1871	" " " constructing sewer in Lippitt street,		1,789 80
1872	George E. Leach, " " " Thayer street,		631 80
1873	Patrick Smith, contract reservation sewer in Sutton street,		40 15
1874	John O'Donnell, " " " " Langley street,		53 28
1875	Charles H. Pierce, paying laborers, &c.,		615 38
1876	" " " " " "		3,053 90
1877	" " " on account for paying laborers, &c.,		300 00
1878	C. Frank Allen, salary as inspector of sewer pipe,		125 00
	Amount carried forward,		\$61,729 37

	Amount brought forward,	\$64,729 37
1879	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
1880	Lucius J. Sampson, salary as engineer of private drains,	100 00
1881	Thomas R. Belcher, " " inspector on sewers,	100 00
1882	William H. Kelly, testing cement,	38 90
1883	Patrick Smith, contract reservation, sewer in Keeno street,	114 10
1884	Alfred Mundell, concrete laid in basins of Eagle street sewer,	13 00
1885	William Elsbree, paving stones,	20 37
1886	Calvin C. Campbell, catch basin stones,	213 00
1887	A. A. Mundell, oil, &c.,	40 36
1888	Wightman & Liscoomb, oil, &c.,	8 59
1889	Providence Builders Association, sewer pipe,	9 98
1890	Narragansett Brick Co., bricks,	145 10
1891	R. H. Purinton, calking tools, oakum, &c.,	14 73
1892	Henry Blundell, agent, labor and materials,	34 75
1893	A. C. Eddy & Studleys, rubber boots, &c.,	62 95
1894	" " " " " "	48 11
1895	William Whittaker, salary as inspector on sewers,	135 10
1896	Lucius J. Sampson, horse hire,	27 00
1897	Robert Morrow, horse hire by engineers,	63 00
1898	Providence Tool Co., tools,	16 75
1899	Rhode Island Concrete Co., concreting around catch basins, &c.,	22 50
1900	Hopkins & Pomroy, cement, carting bricks, &c.,	768 99
1901	William H. Miller & Co., repairing tools, &c.,	37 09
1902	Providence Steam and Gas Pipe Co., labor, pipe and fittings,	19 19
1903	Patrick Smith, constructing sewer in Broad, Somerset and Pine streets,	236 87
1904	Patrick Smith, extra labor, &c , on sewers,	67 53
1905	G. & C. P. Hutchins, lanterns, lantern globes, &c.,	132 91
1906	John O' Donnell, extra labor, &c., sewer in Langley street,	74 31
1907	Smith Granite Co., catch basin stones,	1,190 00
1908	Charles H. Pierce, paid by him for sundries,	30 99
1909	" " " " " "	6 23
1910	Allen Aldrich, horse hire, &c.,	70 00
1911	William H. Miller & Co., repairing tools,	7 02
1912	James Haggarty, rent of House on Blackstone street,	16 50
1913	William H. Fenner & Co., well buckets, well pipe, &c.,	93 95
1914	Charles H. Pierce, paying laborers, &c.,	219 58
1915	" " " " " "	2,465 60
1916	" " " on account for paying laborers, &c.,	2-0 00
1917	James R. Osgood & Co., drawings for sewer report,	215 00
1918	Albert Dailey & Co., lumber,	413 59
1919	George W. Smith, cutting curbing,	7 43
1920	Henry W. Ellis, repairing tools, &c.,	73 32
1921	Providence Water Works, wharfage, labor, &c.,	4,007 26
1922	Albert Tripp & Co., lumber, labor, &c.,	170 77
1923	Providence & Worcester R. R., freight of sewer pipe, (charged to Akron Sewer Pipe Association.)	111 33
1924	Providence Water Works, labor and wharfage,	16 50
1925	Barker, Whitaker & Co., chain,	5 23
1926	" " " tools, &c.,	121 67
1927	Providence Water Works, services of engineers, &c.,	33 263 96
1928	Gilmore & Judge, contract reservation, sewer in Carpenter and Battey streets,	63 67
	Amount carried forward,	\$110,196 58

REPORT ON SEWERS.

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	Amount brought forward,	.	.	.	\$110,196 50
1929	Charles H. Pierco, paying laborers, &c.,	.	.	.	3,166 29
1930	" " " " " "	.	.	.	222 68
1931	" " on account for paying laborers, &c.,	.	.	.	200 00
1932	George B. Inman, contract reservation, sewer in Arnold street,	.	.	.	8 87
1933	" " " " " " George street,	.	.	.	61 24
1934	Alfred Mundell, " " " " Clemence street,	.	.	.	12 72
1935	Providence & Worcester Railroad, freight of sewer pipe, (charged to Akron Sewer Pipe Association,)	.	.	.	111 60
					<u>\$113,979 98</u>

TRIAL BALANCE OF BOARD OF WATER COMMISSIONERS' LEDGER,
SEWER DEPARTMENT, FEBRUARY 29, 1876.

Dr.

Books, stationery, etc.,	\$43 55
Building on Cove lands,	129 15
Stones from Brook street sewer,	2,123 31
Carting stones from sewers to Cove lands,	1,032 62
Shed for storing materials,	360 49
Tools,	4,658 74
Printing,	2,891 04
Inspection of connections,	4,737 64
Inspection of sewer pipe,	459 08
Sewer pipes, rings, covers, &c,	15,019 59
Bricks,	7,455 02
Catch-basin stones,	5,851 20
Catch-basin covers,	442 23
Catch-basin traps,	976 98
Manhole frames and covers,	1,031 80
Manhole stones,	76 01
Lamphole frames and covers,	65 03
Invert blocks,	1,206 40
Iron sewer connections,	68 55
Iron rods,	35 02
Sheet piling,	496 24
Salaries and office expenses,	17,309 46
City Treasurer,	10,199 73
Additional catch-basins,	1,321 38
Additional work on sewers,	1,153 84
Catch-basins in Exchange street and Exchange place,	965 67
Catch-basins in Hope street,	932 85
Catch-basin in Park street,	144 36
Catch-basin in Benefit street, near Thomas street,	132 24
Catch-basin corner of Eddy and Ship streets,	140 35
Catch-basins corner of Hopkins and South Main streets,	243 51
Sewer in Cary street, from Plane to Mary street,	1,481 71
" " Borden street, from Plane to Eddy street,	3,666 20
" " Plane and Blackstone streets,	19,067 46
" " Federal street, from Bradford street to Broadway,	2,827 30
" " Atwell's avenue, from Acorn to Dean street,	43 21
" " Pine street, from Dyer street to Hay street,	301 87
" " Lippitt street, from Camp to North Main street,	9,463 49
" " Ship and Dyer streets,	9 07
Leach & Co., for Atwell's avenue, from Acorn to Dean street	116 13
William H. Bowen,	44 96
John Gillen,	15 30
Charles H. Pierce,	200 00
Completed sewers,	731,033 07
Engineering department, for horse hire,	3,026 85
" " " books, stationery, &c.,	51 59
" " " printing,	624 80
" " " instruments,	190 94
Amount carried forward,	\$855,055 34

REPORT ON SEWERS.

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Amount brought forward,	.	\$855,035 84	
Superintendence of cleaning and repairs,	.	2,791 55	
Cleaning catch-basins and sewers,	.	15,450 02	
Cleaning and repairing old-sewers,	.	7,282 96	
Repairing new sewers,	.	8,212 38	
Alterations caused by change of grades,	.	1,237 56	
			\$885,029 81

CR.

George B. Inman, for High, Courtland, Carpenter and Fountain streets,	.	641 20	
Bernard Swift, for Knight street, from Brighton to Carpenter street,	.	31 70	
Bernard Swift, for Knight street, from Carpenter to Washington street,	.	15 00	
Bernard Swift, for Knight street, from High street, south only, to its summit,	.	20 43	
Bernard Swift, for High street, from Battey to Knight street,	.	22 73	
" " " Olive street, from near Prospect to Thayer street,	.	175 00	
J. W. & J. J. Newman, for Olney street, from Mallett to North Main street,	.	268 40	
J. W. & J. J. Newman, for Eddy street, from Broad to Pine street,	.	10 00	
J. W. & J. J. Newman, for North Main, Hewes and Stevens streets,	.	178 00	
James J. Newman, for Federal street from Bradford street to Broadway,	.	60 00	
Patrick Smith, for Beacon and Maple streets,	.	98 81	
" " " Vinton street, from Asia street to Broadway,	.	30 00	
Patrick Smith, for Courtland street, from Carpenter street to Broadway,	.	40 00	
Patrick Smith, for Bridgham street, from Cranston to Central street,	.	100 00	
Patrick Smith, for Pearl street, from Cranston to Central street,	.	110 00	
Patrick Smith, for Broad, Somerset and Pine streets,	.	190 11	
Willard F. Inman, for High, Knight, Washington and Battey streets,	.	270 00	
Willard F. Inman, for Benefit street, from Angell to College street,	.	73 21	
Willard F. Inman, for Greenwich, Burnett and Public streets,	.	50 00	
Willard F. Inman, for Lippitt street, from Camp to North Main street,	.	275 69	
Leach & Co., for Borden street, from Plane to Eddy street,	.	85 00	
" " " Arnold street, from East to Governor street,	.	15 00	
" " " Thayer street, from George to Charles Field street,	.	98 7	
Leach & Co., for Arnold street, from Brook street, westerly, to its summit,	.	46 20	
Leach & Co., for Peck street, from Weybosset to Dyer street,	.	23 85	
" " " Carpenter street, from Fountain to Battey street,	.	24 28	
George E. Leach, for Thayer street, from Waterman to George street,	.	85 00	
Amounts carried forward,	.	\$3,145 36	\$885,029 81

Amounts brought forward,	\$3,145 36	\$885,029 81
Alfred Mundell, for Pond street, from Summer to Fenner street.	65 00	
Alfred Mundell, for Pond, Summer and Pond streets,	170 00	
" " " Eagle street, from Atwell's avenue to Woonasquatucket river,	37 07	
Gilmore & Judge, for Vinton street, from Vernon to Carpenter street,	8 25	
Akron Sewer Pipe Association,	477 08	
Smith Granite Co.,	448 05	
Approved bills,	880,079 00	
		<u>\$885,029 81</u>

TRIAL BALANCE OF LEDGER. COMMITTEES APPOINTED BY THE BOARD
OF ALDERMEN, TO CONSTRUCT CERTAIN SEWERS, FEBRUARY 29, 1876.

DR.

Approved bills,	\$391,905 72
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CR.

Thomas Newman, for Pearl street, from Broad to Mumford						
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street,	1,590 36	
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Approved bills,	890,315 36	
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					<hr/>	\$391,905
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RECEIVED BY THE BOARD OF WATER COMMISSIONERS, SEWER
DEPARTMENT, FROM DECEMBER 1, 1875, TO FEBRUARY 20, 1876, INCLU-
SIVE, AND PAID TO THE CITY TREASURER.

1875.

December 4.	Of William H. Low, for labor, cleaning private connection, . . .	10 00
7.	Of J. W. & J. J. Newman, for labor and materials, . . .	6 97
14.	Of City of Providence, for labor and materials furnished highway department, . .	776 13
24.	Of David W. Barney, for labor cleaning private connection, . . .	3 00

1876.

January 15.	Of David Frank, for labor, cleaning private connection, . . .	7 50
25.	Of Thomas Cosgrove, for labor, cleaning private connection, . . .	2 00
29.	Of J. W. & J. J. Newman, for amount paid for repairing engine, . . .	5 81
February 24.	Of C. Newcomb & Co., for labor, cleaning private connection, . . .	5 00
February 6.	Of City of Providence, for labor and materials, constructing drain for surface water, in Eagle street, (charged to appropriation for highways by order of the city council,) . . .	2,004 83
	Of City of Providence, for labor and materials, constructing drain for surface water, in Greenwich. Burnett and Public streets, (charged to appropriation for highways by order of the city council,) . .	1,739 78
	Of City of Providence, for sewer materials, furnished highway department, . .	932 07
28.	Of Atlantic DeLaine Co., for labor, cleaning private connection, . . .	5 00
9.	For labor filling cisterns with Pawtuxet water, &c, . . .	64 00

\$5,562 08

1876.]

MASS. STATE BOARD OF HEALTH
CITY DOCUMENTS
ENGINEER'S OFFICE.

NINTH REPORT

OF THE BOARD OF

WATER COMMISSIONER

OF THE

CITY OF PROVIDENCE.

[Elected February 27, 1874.]

ON

SEWERS,

JUNE 1, 1876.



PROVIDENCE:

PROVIDENCE PRESS COMPANY, PRINTERS TO THE CITY.
1876.

1876.]

CITY DOCUMENT.

[No. 29.]

NINTH REPORT

OF THE BOARD OF

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE.

[Elected February 27, 1874.]

ON

SEWERS,

JUNE 1, 1876.



PROVIDENCE:
PROVIDENCE PRESS COMPANY, PRINTERS TO THE CITY.
1876.

ORGANIZATION
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT.

CHARLES E. CARPENTER,

WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.

Office No. 35 North Main Street.

CHIEF ENGINEER.

J. HERBERT SHEDD.

Office No. 35 North Main Street.

REPORT.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
Providence, R. I., June 1, 1876. }

TO THE HONORABLE THE CITY COUNCIL:

The Board of Water Commissioners, elected February 27th, 1874, respectfully present their Ninth Quarterly Report on Sewers.

Since the date of the last report sewers have been ordered by the City Council, as follows:

Angell, Gano and Pitman streets, from Arlington avenue to Cold Spring Brook.

Arch and Greenwich streets, from near Junction street to Broad street.

Benevolent street, from Brook street to Hope street.

Blackstone street, from the present terminus to Allen's avenue.

Charles street, from Randall square to Orms street.

Cranston street, from Pearl street to Winter street.

Dorrance and Cove streets, from Westminster street to West Exchange street.

Dorrance street, from the head of the dock to the end of the pier, whenever the right of way is secured.

Elbow street, from Chestnut street to Hospital street.

Friendship street, from its present terminus above Richmond street to Dorrance street.

Hayward street, from Pearl street to a point fifty feet west of the west line of Portland street.

Lester street, from Bridgham street to D street.

Power street, from the summit near Brown street to Brook street.

Sheldon street, from Brook street to the summit between Benefit and Traverse streets.

The following sewers have been completed since the date of the last report :

"Across High street, and through the land now belonging to Alfred Anthony and Samuel A. Irons, from the southerly side of High street, near the Johnston line, at or near the place where the stone culvert is now, to the Woonasquatucket river."

Arch and Greenwich streets, from near Junction street to Broad street.

Atwell's avenue, from Acorn street to Dean street.

Benevolent street from Brook street to Hope street.

Elbow street, from Chestnut street to Hospital street.

Lester street, from Bridgham street to D street.

Lippitt street, from Camp street to North Main street.

Pearl street, from the Pearl street sewer at Beacon street to Plane street.

Pond street, from the summit between Spring and Winter streets to Pearl street.

Ship and Dyer streets, from Richmond street to Dorrance street.

Tower street, from Atwell's avenue to Federal street.

The following sewer has been completed, with the exception of five catch-basins, which are not to be built until the street is graded and curbed :

Plane and Blackstone streets, from Dudley street to tide-water.

The accounts in relation to the following completed sewers are not yet in readiness for a statement of their cost :

"Across High street and through the land now belonging to Alfred Anthony and Samuel A. Irons, from the southerly side of High street, near the Johnston line, at or near the place where the stone culvert is now, to the Woonasquatucket river."

Arch and Greenwich streets, from near Junction street to Broad street.

Atwell's avenue, from Acorn street to Dean street.

Benevolent street, from Brook street to Hope street.

Borden street, from Hospital street to Eddy street.

Crary street, from Plane street to Mary street.

Elbow street, from Chestnut street to Hospital street.

Federal street, from Bradford street to Broadway.

Lester street, from Bridgham street to D street.

Lippitt street, from Camp street to North Main street.

Olive street, from the summit between Prospect and Thayer streets to Thayer street.

Pearl street, from the Pearl street sewer at Beacon street to Plane street.

Pine street, from Dyer street to Hay street.

Plane and Blackstone streets, from Dudley street to tide-water.

Pond street, from the summit between Spring and Winter streets to Pearl street.

Ship and Dyer streets, from Richmond street to Dorrance street.

Tower street, from Atwell's avenue to Federal street.

The following sewers, ordered by the City Council, are in a state of progress, as follows :

Borden street, from Plane street to Hospital street, completed except one catch-basin.

Charles street, from Randall square to Orms street; work commenced 31st ultimo.

Friendship street, from its present terminus above Richmond street to Dorrance street; completed between Dorrance and Potter streets.

Power street, from the summit near Brown street to Brook street; about one hundred feet of sewer built.

Work on the following sewers, (completing the list ordered to be constructed by the Board of Water Commissioners,) has not been commenced.

Angell, Gano and Pitman streets, from Arlington avenue to Cold Spring Brook.

Blackstone street, from the present terminus to Allen's avenue.

Cranston street, from Pearl street to Winter street.

Dorrance street, from the head of the dock to the end of the pier.

Dorrance and Cove streets, from Westminster street to West Exchange street.

Friendship, West Friendship and Dudley streets, from Greenwich street to Plane street.

Hayward street, from Pearl street to a point fifty feet west of the west line of Portland street.

Sheldon street, from Brook street to the summit between Benefit and Traverse streets.

Drain-Layers' licenses have been issued during the last quarter as follows:

James Brady, Patrick Cooney, J. Frank Read.

The total number of such licenses issued to date, is sixty-three. One licensed drain-layer has deceased. Number of licenses remaining in force sixty-two.

A schedule of sewer bills approved by the Board of Water Commissioners, from March 1, 1876, to May 31, 1876, in-

clusive ; a trial balance of the Board of Water Commissioners' Ledger, Sewer Department, May 31, 1876, inclusive ; a trial balance of the Ledger of the Committees appointed by the Board of Aldermen to build certain sewers, May 31, 1876, inclusive, and a schedule of receipts by the Board of Water Commissioners, paid to the City Treasurer from March 1, 1876, to May 31, 1876, inclusive, are hercunto appended, and made parts of this report.

JOSEPH J. COOKE,	}	<i>Board of Water Commissioners.</i>
CHAS. E. CARPENTER,		
WILLIAM CORLISS,		

REPORT ON SEWERS.

11

	Amount brought forward,	\$7,936 72
1974	Patrick Smith, reservation, sewer in Beacon and Maple streets,	96 81
1975	Leach & Co., " " " Borden street,	85 00
1976	Akron Sewer Pipe Association, sewer pipes,	533 31
1977	James R. Osgood & Co., plans of drainage,	20 00
1978	Allen Fire Department Supply Co., tools, etc.,	7 05
1979	Providence & Worcester Railroad Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association),	208 48
1980	George W. Hall & Co., sewer pipes,	42 00
1981	" " " cement,	6 00
1982	Charles H. Pierce, paying laborers, etc.,	1,748 87
1983	" " " " " "	308 25
1984	Providence & Worcester Railroad Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association),	191 80
1985	Providence & Worcester Railroad Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association),	91 30
1986	Patrick Smith, reservation, sewer in Bridgham street,	95 68
1987	" " " " " Vinton street,	29 55
1988	Bernard Swift, " " " Knight street, from Carpen- ter to Washington street,	8 86
1989	Bernard Swift, reservation, sewer in Knight street, from Brigh- ton to Carpenter street,	30 75
1990	Bernard Swift, reservation, sewer in Knight street from High street, southerly to its summit,	1 87
1991	Bernard Swift, reservation, sewer in High street.	5 29
1992	C. Frank Allen, salary as inspector of sewer pipes,	125 00
1993	Lucius J. Sampson, salary as engineer of private drains,	100 00
1994	Allen Aldrich, " " " superintendent of cleaning and re- pairs,	100 00
1995	Thomas R. Belcher, salary as inspector on sewers,	100 00
1996	William Whittaker, " " " " " "	117 00
1997	William B. Kelly, testing cement,	49 70
1998	Charles H. Pierce, paid by him for sundries,	25 18
1999	Barker, Whittaker & Co., tools, nails, etc.,	142 02
2000	W. Congdon & Sons, tape measure,	5 00
2001	Robert Morrow, horse hire by engineers,	13 50
2002	L. J. Sampson, use of horse and wagon,	42 00
2003	Bugbee & Hall, stationery,	7 46
2004	Haight & Southard, bricks,	1,235 25
2005	Charles H. Pierce, paid by him for sand,	20 00
2006	A. Aldrich, use of horse and wagon, etc.,	57 75
2007	Hopkins & Pomroy, coal,	4 50
2008	Bugbee & Hall, stationery,	7 18
2009	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard),	238 00
2010	George W. Smith, stone cutting,	19 58
2011	Smith Granite Co., catch basin stones,	1,370 00
2012	Charles H. Pierce, paying laborers, etc.,	539 89
2013	" " " " " "	1,516 69
2014	George B. Inman, reservation, sewer in High, Courtland, Carpen- ter and Fountain streets,	605 25
2015	Providence and Worcester Railroad Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association),	92 25
2016	Schooner J. Terry, on account for freight of bricks, (charged to Haight & Southard,)	39 86
	Amount carried forward,	\$18,019 79

	Amount brought forward,	\$ 18,019 79
2017	Albert Terry, freight of bricks per schooner J. Terry, (charged to Haight & Southard),	128 64
2018	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard),	237 50
2019	Charles T. Place, oil and tallow,	13 21
2020	Wm. H. Miller & Co., repairing tools, etc.,	18 65
2021	Henry W. Ellis, " " "	23 65
2022	Barker, Whitaker & Co., tools, etc.,	30 60
2023	Dexter, Gorton & Co., repairing centres,	7 30
2024	Stanton Clark, agent, side coping stone,	9 00
2025	William Elsbree, paving stones,	9 00
2026	A. C. Eddy & Studleys, rubber boots,	23 75
2027	Patrick Smith, recovering sewer pipe on Keene street, etc.,	33 75
2028	Leach & Co., reservation, sewer in Arnold street,	15 00
2029	Hopkins & Pomroy, cement, carting bricks, teaming, etc.,	1,004 74
2030	Haight & Southard, bricks,	2,084 90
2031	Wm. H. Miller & Co., repairing tools,	4 85
2032	A. C. Eddy & Studleys, rubber boots,	20 14
2033	Edward Burr, repairing harness, etc.,	11 50
2034	John H. Eddy, palls and brooms,	5 14
2035	Hammond, Angell & Co., printing,	169 88
2036	A. A. Mundell, oil, etc.,	7 28
2037	Providence & Worcester Railroad Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association,)	390 04
2038	Charles H. Pierce, paid by him for sundries,	13 54
2039	Akron Sewer Pipe Association, sewer pipes,	2,169 31
2040	Schooner William H. Bowen, freight of sewer pipe, (charged to G. W. Rader & Co.,)	62 33
2041	Willard F. Inman, reservation, sewer in Benefit street,	73 21
2042	W. E. Barrett & Co., tools,	17 70
2043	Charles H. Pierce, paying laborers, etc.,	996 92
2044	" " " " "	1,566 07
2045	J. W. & J. J. Newman, reservation, sewer in Eddy street,	10 00
2046	Patrick Smith, on account for constructing sewer in Pond street,	500 00
2047	C. Frank Allen, salary as inspector of sewer pipes,	125 00
2048	Lucius J. Sampson, salary as engineer of private drains,	100 00
2049	Rencellaer B. S. Hart, salary as inspector of private drains,	56 00
2050	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
2051	William Whittaker, salary as inspector on sewers,	100 00
2052	Thomas R. Belcher, " " " " "	100 00
2053	Duty J. Greene, " " " " "	86 00
2054	William Bowler, " " " " "	43 00
2055	Henry F. Davis, " " " " "	64 00
2056	William H. Smith, " " of sewer materials,	6 00
2057	Providence & Worcester Railroad Co., freight of sewer pipes, (charged to Akron Sewer Pipe Association,)	469 69
2058	Smith Granite Co., catch basin stones,	645 00
2059	Robert Morrow, horse hire by engineers,	57 00
2060	James Heagarty, rent of house on Blackstone street,	16 50
2061	Lucius J. Sampson, use of horse and wagon,	75 00
2062	Henry Staples & Co., tarred paper, etc.,	4 09
2063	Albert Dailey & Co., lumber,	16 07
2064	Barker, Whitaker & Co., tools, etc,	8 27
2065	S. A. Thornton, carpenter's work and lumber,	26 13
	Amount carried forward,	\$29,731 08

13

	Amount brought forward,	\$29,731 08
2066	Fuller Iron Works, manhole covers and catch basin cover,	13 43
2067	Allen Aldrich, use of horse and wagon,	73 00
2068	Barker, Whitaker & Co., tools, etc.,	14 80
2069	James Heagarty, rent of house on Blackstone street,	18 50
2070	Hopkins & Pomroy, cement, carting bricks, teaming, etc.,	1,178 87
2071	Gilmore & Judge, reservation, sewer in Vinton Street,	8 25
2072	Leach & Co., " Arnold street,	43 57
2073	Alfred Mundell, " Pond street,	65 00
2074	Charles H. Pierce, paid by him for sundries,	44 58
2075	George E. Weaver, tools, etc.,	19 98
2076	Wm. H. Miller & Co., tools, etc.,	7 67
2077	" " " "	7 41
2078	Thomas Phillips & Co., " "	17 00
2079	Akron Sewer Pipe Association, sewer pipes,	160 10
2080	" " " "	533 97
2081	William H. Kelley, testing cement,	49 50
2082	Charles H. Pierce, paying laborers,	1,199 61
2083	" " " "	493 25
2084	Leach & Co., on account for constructing sewer in Atwell's avenue,	1,085 00
2085	Wood & Winsor, labor, etc.,	4 32
2086	" " labor, nipples, etc.,	4 86
2087	Patrick Smith, constructing sewer in Pond street,	106 54
2088	Willard F. Inman, reservation, sewer in Greenwich, Burnett and Public streets,	50 00
2089	J. W. & J. J. Newman, constructing sewer in Ship and Dyer streets,	2,426 73
2090	" " extra labor, etc., " " " "	35 23
2091	" " labor on account of change of grade on Clifford, Eddy and Friendship streets,	6 90
2092	Delaney & Walsh, repairing tools,	4 20
2093	Albert Tripp & Co., lumber, nails, etc.,	13 80
2094	Patrick Smith, extra labor, sewer in Pond street,	7 58
2095	G. W. Rader & Co., sewer pipes, etc.,	1,387 70
2096	Providence Water Works, salaries and office expenses, etc.,	602 58
2097	Dexter Gorton & Co., repairing fence and steps, sewer in Plane and Blackstone streets, etc.,	24 53
2098	Alfred Mundell, reservation, sewer in Pond, Summer and Broad streets,	170 00
2099	Patrick Smith, reservation, sewer in Courtland street,	38 50
2100	Rhode Island Concrete Co., concreting around catch basins,	5 25
2101	" " " "	4 25
2102	Charles H. Pierce, paying laborers, etc.,	448 69
2103	" " " "	1,568 45
2104	Providence & Worcester Railroad Co., freight of sewer pipes, (charged to Akron Sewer Pipe Association,)	69 30
2105	Willard F. Inman, reservation, sewer in High, Knight, Washington and Battey streets,	228 57
2106	Leach & Co., reservation, sewer in Peak street,	4 85
2107	James J. Newman, reservation, sewer in Federal street,	60 00
2108	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard,)	225 00
		\$42,118 63

TRIAL BALANCE OF BOARD OF WATER COMMISSIONERS' LEDGER,
SEWER DEPARTMENT, MAY 31, 1874.

DR.

Books, stationery, etc.,	.	.	.	\$49 11
Building on Cove lands,	.	.	.	129 15
Stones from Brook street sewer,	.	.	.	2,121 31
Carting stones from sewers to Cove lands,	.	.	.	1,932 62
Shed for storing materials,	.	.	.	379 44
Tools,	.	.	.	5,038 74
Printing,	.	.	.	3,080 92
Inspection of connections,	.	.	.	5,093 64
Inspection of sewer pipe,	.	.	.	882 17
Sewer pipes, rings, covers, etc.,	.	.	.	22,029 26
Bricks,	.	.	.	11,670 09
Catch-basin stones,	.	.	.	9,713 17
Catch-basin covers,	.	.	.	421 60
Catch-basin traps,	.	.	.	275 03
Manhole frames and covers,	.	.	.	1,036 96
Manhole stones,	.	.	.	76 01
Lamphole frames and covers,	.	.	.	65 03
Invert blocks,	.	.	.	1,548 10
Iron sewer connections,	.	.	.	68 95
Iron rods,	.	.	.	85 02
Sheet piling,	.	.	.	593 31
Salaries and office expenses,	.	.	.	18,652 08
City treasurer,	.	.	.	10,405 91
Additional catch-basins,	.	.	.	1,336 67
Additional work on sewers,	.	.	.	1,191 44
Catch-basins in Exchange street and Exchange place,	.	.	.	671 20
Catch-basins in Hope Street,	.	.	.	533 06
Catch-basin in Park street,	.	.	.	144 36
Catch-basin in Benefit street, near Thomas street,	.	.	.	132 24
Catch-basin corner of Eddy and Ship streets,	.	.	.	140 35
Catch-basins corner of Hopkins and South Main streets,	.	.	.	246 68
Sewer in Crary street, from Plane to Mary street,	.	.	.	1,568 56
“ “ Borden street, from Plane to Eddy street,	.	.	.	4,028 30
“ “ Ship and Dyer streets,	.	.	.	3,098 81
“ “ Lippitt street, from Camp to North Main street,	.	.	.	9,634 01
“ “ Federal street, from Bradford street to Broadway,	.	.	.	2,399 82
“ “ Atwell's avenue, from Acorn to Dean street,	.	.	.	355 30
“ “ Pine street, from Dyer to Hay street,	.	.	.	436 21
“ “ Pearl street, from Beacon to Plane street,	.	.	.	4,591 57
“ “ Plane and Blackstone streets,	.	.	.	20,064 91
“ “ Arch and Greenwich streets,	.	.	.	1,714 54
“ “ Pond street, from near Winter to Pearl street,	.	.	.	854 45
Amount carried forward,	.	.	.	\$149,332 10

REPORT ON SEWERS.

15

Amount brought forward,	\$149,332 10
Sewer across High street, through private property to Woonasquatucket river,	1,378 78
Sewer in Tower street, from Atwell's avenue to Federal street,	464 19
Sewer in Elbow street, from Hospital to Chestnut street,	207 52
" " Lester street, from D to Bridgham street,	154 20
" " Benevolent street, from Hope to Brook street,	518 92
Leach & Co., for Atwell's avenue from Acorn to Dean street,	1,149 12
Testing cement,	71 12
John Gillen,	15 30
Board of commissioners of new R. I. State prison,	51 00
Union Railroad Co.,	4 52
J. W. & J. J. Newman,	45
Thomas Thorp,	17 40
Haight & Southard,	225 00
Completed sewers,	734,023 07
Engineering department for horse hire,	3,247 35
" " " books, stationery, etc.,	63 03
" " " printing,	624 80
" " " instruments,	195 94
" " " sundries,	41 50
Superintendence of cleaning and repairs,	3,091 55
Cleaning catch-basins and sewers,	17,873 02
Cleaning and repairing old sewers,	7,774 66
Repairing new sewers,	3,057 53
Alterations caused by change of grades,	1,246 15
	<hr/> \$925,523 23

CR.

Willard F. Inman, for High, Knight, Washington and Battery streets,	\$3 72
Willard F. Inman, for Lippitt street, from Camp to North Main street,	274 72
Leach & Co., for Thayer street, from George to Charles Field street,	85 55
Leach & Co., for Carpenter street, from Fountain to Battery street,	24 28
George E. Leach, for Thayer street, from Waterman to George street,	85 00
Patrick Smith, for Pearl street, from Cranston to Central street,	110 00
Patrick Smith, for Broad, Somerset and Pine streets,	199 11
Patrick Smith, for Pond street, from near Winter to Pearl street,	25 69
Bernard Swift, for Olive street, from near Prospect to Thayer street,	173 70
J. W. & J. J. Newman, for North Main, Hewes and Stevens streets,	178 00
J. W. & J. J. Newman, for Ship and Dyer streets,	130 00
Alfred Mundell, for Eagle street, from Atwell's avenue to Woonasquatucket river,	37 07
Akron Sewer Pipe Association,	1,043 01
Smith Granite Co.,	356 75
Approved bills,	922,797 63
	<hr/> \$925,523 23

TRIAL BALANCE OF LEDGER, COMMITTEES APPOINTED BY THE
BOARD OF ALDERMEN TO CONSTRUCT CERTAIN SEWERS, May 31,
1876.

DR.

Approved bills,	\$391,905 72
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CR.

Thomas Newman, for Pearl street, from Broad to Mum-						
ford street,	\$1,590 36	
Approved bills,	\$90,315 36	
					<hr/>	\$391,905 72

RECEIVED BY THE BOARD OF WATER COMMISSIONERS, SEWER DE-
PARTMENT, FROM MARCH 1, 1876, TO MAY 31, 1876, INCLUSIVE, AND
PAID TO THE CITY TREASURER.

1876.

March 10.	Of Thomas J. Hill, for cracked sewer pipe,	.	.	76 50
14.	Of James Jordan, for rent of house on Blackstone street,	.	.	3 36
25.	Of J. W. & J. J. Newman, for rope, etc.,	.	.	14 78
April 1.	Of William H. Bowen, for labor and materials,	.	.	45 31
11.	Of J. B. Barnaby, for labor, cleaning private connection,	.	.	2 00
25.	Of Michael Connelly, for removing sand from Pond street sewer,	.	.	4 25
May 2.	Of Providence County Court House, for testing cement,	.	.	35 00
	Of Isaac Hartshorn, for labor, cleaning private connections,	.	.	2 00
31.	For labor filling cisterns with Pawtuxet water,	.	.	23 00
				<hr/>
				\$206 18

~~MASS. STATE BOARD OF HEALTH~~

1876.]

~~CITY ENGINEERS' OFFICE,~~
DOCUMENT. [No. 8]

TENTH REPORT

OF THE BOARD OF

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE,

[Elected February 27, 1874.]

ON

SEWERS,

SEPTEMBER 1, 1876.



PROVIDENCE:

PROVIDENCE PRESS COMPANY, PRINTERS TO THE CITY.
1876.

1876.]

CITY DOCUMENT.

[No. 39.]

TENTH REPORT

OF THE BOARD OF

WATER COMMISSIONERS

OF THE

CITY OF PROVIDENCE,

[Elected February 27, 1874.]

ON

SEWERS.

SEPTEMBER 1, 1876.



PROVIDENCE:

PROVIDENCE PRESS COMPANY, PRINTERS TO THE CITY.

1876.

ORGANIZATION
OF THE
PROVIDENCE WATER WORKS.

BOARD OF WATER COMMISSIONERS.

JOSEPH J. COOKE, PRESIDENT,
CHARLES E. CARPENTER,
WILLIAM CORLISS.

SECRETARY OF THE BOARD OF WATER COMMISSIONERS.

CLINTON D. SELLEW.

Office No. 35 North Main Street.

CHIEF ENGINEER.

J. HERBERT SHEDD.

Office No. 35 North Main Street.

REPORT.

OFFICE OF THE BOARD OF WATER COMMISSIONERS, }
Providence, R. I., September 1, 1876. }

TO THE HONORABLE THE CITY COUNCIL:—

The Board of Water Commissioners elected February 27th, 1874, respectfully present their Tenth Quarterly Report on Sewers.

Since the date of the last report, sewers have been ordered by the City Council, as follows :

Brook street, from Meeting street to Angell street.

Dean and Washington streets, from the summit in Washington street, east of Dean street to Fountain street.

Pallas street, from Vernon street to Carpenter street.

Providence street, from Lockwood street to Pearl street.

Richmond street, from Clifford street to Friendship street.

The following sewers have been completed since the date of the last report, but the accounts are not yet in readiness for a statement of their cost :

Brook street, from Meeting street to Angell street.

Charles street, from Randall square to Orms street.

Cranston street, from Pearl street to Winter street.

Dean and Washington streets, from the summit in Washington street, east of Dean street to Fountain street.

"Friendship street, from its present terminus above Richmond street to Dorrance street."

Hayward street, from Pearl street to a point fifty feet west of the west line of Portland street.

Pallas street, from Vernon street to Carpenter street.

Power street, from the summit near Brown street to Brook street.

Providence street, from Lockwood street to Pearl street.

Richmond street, from Clifford street to Friendship street.

Sheldon street, from Brook street to the summit between Benefit and Traverse streets.

The following sewer has been completed with the exception of one catch-basin, which is not to be built until Clay street is graded and curbed :

Borden street, from Plane street to Hospital street.

The accounts in relation to the following sewers, heretofore reported as completed, are not yet in readiness for a statement of their cost.

"Across High street, and through land now belonging to Alfred Anthony and Samuel A. Irons; from the southerly side of High street, near the Johnston line, at or near the place where the stone culvert is now, to the Woonasquatucket river."

Arch and Greenwich streets, from near Junction street to Broad street.

Benevolent street, from Brook street to Hope street.

Elbow street, from Chestnut street to Hospital street.

Lester street, from Bridgham street to D street.

Pearl street, from the Pearl street sewer at Beacon street to Plane street.

Pine street, from Dyer street to Hay street.

Plane and Blackstone streets, from Dudley street to tide-water.

Pond street, from the summit between Spring and Winter streets to Pearl street.

Tower street, from Atwell's avenue to Federal street.

The following sewers ordered by the City Council, are in a state of progress as follows :

Dorrance and Cove streets, from Westminster street to West Exchange street; about 1,850 feet of sewer completed.

Friendship, West Friendship and Dudley streets, from Greenwich street to Plane street; about 900 feet of 22 inch by 33 inch and about 1,100 feet of 20 inch by 30 inch sewer completed.

Work on the following sewers (completing the list ordered to be constructed by the Board of Water Commissioners,) has not been commenced :

Angell, Gano and Pitman streets, from Arlington avenue to Cold Spring brook.

Blackstone street, from the present terminus to Allen's avenue.

Dorrance street, from the head of the dock to the end of the pier.

The accounts in relation to the following completed sewers have been made up, and the cost of each is as follows :

<i>Atwell's avenue, from Acorn street to Dean street,</i>	\$3,792 68
<i>Borden street, from Hospital street to Eddy street,</i>	
<i>and Borden street from Plane street to Hos-</i>	
<i>pital street,</i>	4,883 03
<i>Crary street, from Plane street to Mary street, .</i>	1,669 69
<i>Federal street, from Bradford street to Broadway,</i>	2,524 52
<i>Lippitt street, from Camp street to North Main</i>	
<i>street,</i>	10,290 30
<i>Ship and Dyer streets, from Richmond street to</i>	
<i>Dorrance street,</i>	5,081 18
	<hr/>
	\$28,241 40

Assessments for the following sewers have been completed and certified to the City Treasurer :

<i>Arch and Greenwich streets, from near Junction street to Broad street,</i>		\$2,011 79
<i>Atwell's avenue, from Acorn street to Dean street,</i>		2,879 18
<i>Benevolent street, from Brook street to Hope street,</i>		1,048 12
<i>Brook street, from Meeting street to Angell street,</i>		787 21
<i>Charles street, from Randall square to Orms street,</i>		863 85
<i>Cranston street, from Pearl street to Winter street,</i>		853 48
<i>Dean and Washington streets, from the summit in Washington street, east of Dean street to Fountain street,</i>		1,055 62
<i>Elbow street, from Chestnut street to Hospital street,</i>		543 73
<i>"Friendship street, from its present terminus above Richmond street to Dorrance street,"</i>		1,861 31
<i>Hayward street, from Pearl street to a point fifty feet west of the west line of Portland street,</i>		514 71
<i>Lester street, from Bridgam street to D street,</i>		296 79
<i>Orms and Charles streets, from the railroad bridge on Orms street to Mill street,</i>		3,068 64
<i>Pallas street, from Vernon street to Carpenter street,</i>		301 85
<i>Pine street, from Dyer street to Hay street,</i>		576 72
<i>Plane and Blackstone streets, from Dudley street to tide-water,</i>		4,266 05
<i>Pond street, from the summit between Spring and Winter streets to Pearl street,</i>		1,127 59
<i>Power street, from the summit near Brown street to Brook street,</i>		2,663 02
<i>Providence street, from Lockwood street to Pearl street,</i>		337 68
Amount carried forward,		<u>\$25,057 34</u>

REPORT ON SEWERS.

9

Amount brought forward, . . .	\$25,057 34
<i>Richmond street, from Clifford street to Friend-</i> <i>ship street, . . .</i>	279 57
<i>Sheldon street, from Brook street to the summit</i> <i>between Benefit and Traverse streets, . . .</i>	1,294 83
<i>Ship and Dyer streets, from Richmond street to</i> <i>Dorrance street, . . .</i>	2,261 77
<i>Tower street, from Atwell's avenue to Federal</i> <i>street, . . .</i>	411 60
	<hr/>
	\$29,305 11

A schedule of sewer bills approved by the Board of Water Commissioners, from June 1, 1876, to August 31, 1876, inclusive; a trial balance of the Board of Water Commissioners' Ledger, Sewer Department, August 31, 1876, inclusive; a trial balance of the Ledger of the Committees appointed by the Board of Aldermen to build certain sewers, August 31, 1876, inclusive, and a schedule of receipts by the Board of Water Commissioners, paid to the City Treasurer from June 1, 1876, to August 31, 1876, inclusive, are hereunto appended and made parts of this report.

JOSEPH J. COOKE,	}	<i>Board of</i> <i>Water Commissioners.</i>
CHAS. E. CARPENTER,		
WILLIAM CORLISS,		

SCHEDULE OF BILLS APPROVED BY THE BOARD OF WATER COMMISSIONERS, SEWER DEPARTMENT, FROM JUNE 1, 1876, TO AUGUST 31, 1876, INCLUSIVE.

2109	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard),	\$224 10
2110	Lucius J. Sampson, salary as engineer of private drains,	100 00
2111	Rencellaer B. S. Hart, " " inspector " "	80 00
2112	Duty J. Greene, " " " " "	80 00
2113	William Whittaker " " " on sewers,	122 39
2114	Thomas R. Belcher, " " " " "	77 42
2115	William Bowler, " " " " "	58 00
2116	Allen Aldrich, " " superintendent of cleaning and repairs,	100 00
2117	Thomas R. Belcher, " " inspector,	22 58
2118	William H. Kelly, testing cement,	49 50
2119	Charles H. Pierce, paid by him for sundries,	31 56
2120	G. & C. P. Hutchins, lanterns, lantern globes, oil, etc.,	53 00
2121	William H. Miller & Co., repairing tools, etc.,	110 27
2122	Wood & Winsor, brass castings, stop cocks, nipples, etc.,	10 30
2123	Robert Morrow, horse hire by engineers, etc.,	75 00
2124	A. A. Mundell, oil, etc.,	9 40
2125	" " " "	8 60
2126	Albert Tripp & Co., lumber, labor, etc.,	22 53
2127	George E. Weaver, lanterns, pails, dippers, etc.,	12 10
2128	Providence & Worcester Railroad Co., freight of sewer pipes, (charged to Akron Sewer Pipe Association),	141 75
2129	James Heagarty, rent of house on Blackstone street,	16 50
2130	T. J. Elliot, agent, pails,	15 00
2131	Lucius J. Sampson, use of horse,	81 00
2132	Fuller Irons Works, iron sewer castings, etc.,	5 78
2133	Smith Granite Co., catch basin stones,	200 00
2134	Allen Aldrich, use of horse and wagon, etc.,	75 55
2135	William H. Miller & Co., repairing tools, etc.,	36 48
2136	Wood & Winsor, pipe, labor, etc.,	13 50
2137	Charles H. Pierce, paying laborers, etc.,	2,615 47
2138	" " " " "	531 19
2139	Patrick Smith, reservation, sewer in Pearl street,	106 96
2140	Leach & Co, " " " Carpenter street,	22 74
2141	Dennis Kearney, oil, etc.,	4 20
2142	Smith Granite Co., catch-basin stones,	463 42
2143	Albert Dalley & Co., lumber,	494 56
2144	Barker, Whittaker & Co., tools, etc.,	225 19
2145	" " " rules, Yale lock and keys, etc.,	4 90
2146	Schooner Phebe Elizabeth, freight of bricks, (charged to Haight & Southard),	98 00
2147	Henry W. Ellis, agent, sharpening tools, etc.,	10 90
2148	Delaney & Walsh, tools and repairing,	28 55
2149	Hopkins & Pomroy, cement, carting bricks, teaming, etc.,	1,061 90
2150	George W. Hall & Co., cement and pipe,	8 40
Amount carried forward		\$7,510 09

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	Amount brought forward,	\$7,510 09
2151	Hopkins & Pomroy, cement and use of team,	8 70
2152	Providence Water Works, salaries and office expenses, etc.,	654 08
2153	Akron Sewer Pipe Association, sewer pipes,	182 70
2154	" " " " "	837 87
2155	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard,)	221 06
2156	A. C. Eddy & Studleys, rubber boots,	31 50
2157	Michael McGuire, labor, sewer in Plane and Blackstone streets,	25 00
2158	A. A. Gray & Co., carpenters' work, lumber, etc.,	149 86
2159	Bernard Swift, reservation, sewer in Olive street,	178 70
2160	Leach & Co., " " Thayer street,	70 76
2161	A. C. Eddy & Studleys, rubber coat,	4 25
2162	Schooner Florence, freight of bricks, (charged to Haight & Southard),	189 65
2163	" " " " "	170 55
2164	Charles H. Pierce, paying laborers, etc.,	2,610 26
2165	" " " " "	446 50
2166	Leach & Co., constructing sewer in Atwell's avenue,	82 47
2167	Providence Press Co., printing,	5 22
2168	James F. Miner, gravel,	51 00
2169	John Mason, templets, etc.,	18 69
2170	Schooner Hannah E. Brown, freight of bricks, (charged to Haight & Southard),	231 75
2171	William Elsbree, paving stones, (charged to W. F. Inman),	18 00
2172	Robert Morrow, horse hire by engineers,	73 00
2173	Rhode Island Concrete Co., concreting around catch-basins,	9 00
2174	B. F. Almy, cop waste and bagging,	4 76
2175	Michael Sullivan, gravel,	48 80
2176	Bugbee & Hall, blank books and stationery,	47 89
2177	" " " " "	8 14
2178	Charles H. Pierce, paying laborers, etc,	2,756 90
2179	" " " " "	211 78
2180	Lucius J. Sampson, salary as engineer of private drains,	100 00
2181	Rencellaer B. S. Hart, " " inspector " " " "	80 00
2182	Duty J. Greene, " " " " " " " "	45 83
2183	Allan Aldrich, salary as superintendent of cleaning and repairs,	100 00
2184	William Whittaker, " inspector on sewers,	109 93
2185	Thomas R. Belcher, " " " " " " " "	100 00
2186	William Bowler, " " " " " " " "	22 00
2187	William H. Kelly, testing cement,	50 62
2188	Willard F. Inman, reservation, sewer in Lippitt street,	229 35
2189	J. W. & J. J. Newman, " " " North Main, Hewes and Stevens streets,	178 00
2190	George E. Leach, reservation, sewer in Thayer street,	85 00
2191	Alfred Mundell, " " Eagle street,	36 51
2192	Charles H. Pierce, on account for paying laborers, etc.,	100 00
2193	People's Concrete Co., concreting,	22 80
2194	Michael Sullivan, gravel,	50 00
2195	James F. Miner, "	183 64
2196	Samuel M. Gray, paid by him for oil, etc.,	6 92
2197	Lucius J. Sampson, use of team,	78 00
2198	Akerman & Co., binding sewerage reports,	27 00
2199	Charles F. Pope, powder, fuse, etc.,	7 75
2200	Henry M. Angell & Co., lumber,	298 55
2201	E. W. Pierce & Co., oil and meal,	16 05
	Amount carried forward,	\$18,206 22

	Amount brought forward,	\$18,206 23
2202	Charles H. Pierce, paid by him for sundries,	34 35
2203	Haight & Southard, bricks,	4,906 34
2204	Allen Aldrich, use of horse and wagon,	75 00
2205	Charles H. Pierce, paid by him for sundries,	16 12
2206	Hopkins & Pomroy, cement, carting bricks, teaming, etc.,	1,781 99
2207	William H. Miller & Co., repairing tools, etc.,	73 83
2208	Barker, Whitaker & Co., tools, etc.,	109 21
2209	Albert Dalley & Co., lumber,	451 96
2210	Alexander Brothers, oil and meal,	8 43
2211	John H. Eddy & Co., pails, brooms, &c.,	9 93
2212	Fuller Iron Works, iron sewer castings, etc.,	926 79
2213	G. & C. P. Hutchins, lanterns, lantern globes, etc.,	23 99
2214	Allen Fire Department Supply Co., repairing steam hose, etc.,	9 33
2215	Grant Brothers, repairing tools,	4 85
2216	Wood & Winsor, steam gauge, etc.,	8 85
2217	James McElroy, labor on sewer in Plane and Blackstone streets,	15 00
2218	Esek Tallman, services examining houses and estimating damages on Blackstone street,	15 00
2219	T. Heffernan, painting signs, "No passing,"	6 00
2220	Albert Tripp & Co., lumber,	11 66
2221	French, McKenzie & Co., making circles,	11 25
2222	Providence & Worcester R. R. Co., freight of sewer pipe, (charged to Akron Sewer Pipe Association,)	69 30
2223	W. Coleman & Sons, tools,	5 85
2224	Wood & Winsor, angle valve, labor, etc.,	8 48
2225	William H. Miller & Co., dressing stone tools,	4 68
2226	Fales, Jenks & Sons, hydrant head,	80 00
2227	George W. Hall & Co., cement.	10 50
2228	Hopkins & Pomroy, cement and use of team,	10 80
2229	Michael Sullivan, gravel,	109 84
2230	James F. Miner, gravel,	224 43
2231	Schooner Victory, freight of sewer pipe, (charged to R. G. Walmaley,)	47 52
2232	Schooner Pointer, freight of invert blocks, (charged to G. W. Rader & Co.,)	18 71
2233	Charles H. Pierce, paying laborers, etc.,	5,178 28
2234	" " " " " "	641 50
2235	Patrick Smith, reservation, sewer in Broad, Somerset and Pine streets,	178 28
2236	Providence Water Works, water used in cleaning catch basins and sewers,	530 96
2237	Providence Water Works, water used in constructing sewers,	210 24
2238	Lucius J. Sampson, salary as engineer of private drains,	100 00
2239	Daniel C. Stone, " " " " " "	45 70
2240	Rencellaer B. S. Hart, " " inspector " " " "	80 00
2241	Allen Aldrich, salary as superintendent of cleaning and repairs,	100 00
2242	William Whittaker, salary as inspector on sewers,	106 65
2243	Thomas R. Belcher, " " " " " "	100 00
2244	William H. Smith, " " " of sewer pipes,	20 00
2245	William H. Kelly, testing cement,	6 75
2246	Charles H. Pierce, paid for diagrams for use of sewer committee,	30 00
2247	Newport & Providence Lead Works, lead,	17 84
2248	Joseph Bardsley, painting T. W. Smith's office on Blackstone street, as advised by City Solicitor,	26 61
2249	Butler, Brown & Co., foot valve,	15 00
	Amount carried forward,	\$34,684 75

REPORT ON SEWERS.

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	Amount brought forward,	\$34,684 75
2250	Tucker, Swan & Co., coal,	42 00
2251	James R. Oswood & Co., maps for use of sewer committee,	40 00
2252	Narragansett Brick Co., bricks,	26 68
2253	Providence & Worcester R. R. Co., freight of sewer pipes, (charged to Akron Sewer Pipe Association),	69 30
2254	Robert Morrow, horse hire by engineers,	63 00
2255	Henry H. Healey, horse hire by engineers,	30 00
2256	Lucius J. Sampson, use of horse,	36 00
2257	William H. Miller & Co., repairing tools, etc.,	65 84
2258	Albert Dalley & Co., lumber,	294 64
2259	Providence Steam & Gas Pipe Co., labor pipe and fittings,	12 04
2260	Charles H. Pierce, paid by him for sundries,	16 98
2261	Delaney & Walsh, tools and repairing,	13 55
2262	Albert Tripp & Co., lumber, carpenter's work, etc.,	9 88
2263	Bugbee & Hall, blank books, etc.,	19 45
2264	George Campbell, sand screen, wire cloth, etc.,	20 1 ²
2265	Fuller Iron Works, iron sewer castings,	971 12
2266	Akron Sewer Pipe Association, sewer pipes,	220 55
2267	Allen Aldrich, use of horse and wagon,	75 00
2268	A. C. Eddy & Studleys, rubber boots,	24 00
2269	Tucker, Swan & Co., coal,	9 00
2270	Hopkins & Pomroy, cement, carting bricks, bricks, teaming, etc.,	4,936 39
2271	E. W. Pierce & Co., oil and meal,	18 85
2272	Henry W. Ellis repairing tools, etc.,	7 90
2273	Barker, Whitaker & Co., tools, nails, etc.,	56 27
2274	Michael Sullivan, gravel,	68 48
2275	James F. Miner, gravel,	174 69
2276	Akron Sewer Pipe Association, sewer pipes,	1,502 20
2277	Pay Roll, construction account, for two weeks ending August 5, '76,	3,128 51
2278	Pay Roll, maintenance account, " " " " 5, '76,	515 74
2279	Schooner Pointer, freight of invert blocks, (charged to G. W. Rader & Co.,)	40 47
2280	Providence Water Works, salaries and office expenses, labor, wharfage, etc.,	2,751 86
2281	Ellery Millard, repairing damage to building on Blackstone street, etc.,	324 40
2282	William T. Smith, repairing damage to building on Blackstone street, etc.,	40 00
2283	William Ellis, repairing damage to building on Blackstone street, etc.,	7 65
2284	Alexander Brothers, oil, meal and soap,	7 42
2285	Henry M. Angell & Co., lumber,	237 72
2286	Pulsometer Iron Works, check valves,	31 50
2287	James F. Miner, gravel,	166 64
2288	Michael Sullivan, gravel,	59 98
2289	Pay Roll, construction account, for two weeks ending Aug. 19, '76,	8,541 77
2290	Pay Roll, maintenance account, " " " " 19, '76,	449 53
2291	Providence Water Works, services of engineers,	1,251 00
		<hr/> \$56,060 43

TRIAL BALANCE OF BOARD OF WATER COMMISSIONERS' LEDGER, SEWER
DEPARTMENT, AUGUST 31, 1876.

DR.

Books, stationery, etc.,	.	.	.	54 13
Building on Cove lands,	.	.	.	129 15
Stones from Brook street sewer,	.	.	.	2,088 31
Carting stones from sewers to Cove lands,	.	.	.	1,932 63
Shed for storing materials,	.	.	.	382 19
Tools,	.	.	.	5,689 15
Printing,	.	.	.	3,108 82
Inspection of connections,	.	.	.	7,427 67
Inspection of sewer pipe,	.	.	.	943 83
Sewer pipes, rings, covers, etc.,	.	.	.	17,672 43
Bricks,	.	.	.	11,598 16
Catch-basin stones,	.	.	.	8,153 34
Catch-basin covers,	.	.	.	322 55
Catch-basin traps,	.	.	.	315 37
Manhole frames and covers,	.	.	.	1,331 16
Lamphole frames and covers,	.	.	.	261 78
Invert blocks,	.	.	.	343 65
Iron sewer connections,	.	.	.	20 76
Iron rods,	.	.	.	13 93
Sheet piling,	.	.	.	1,455 07
Salaries and office expenses,	.	.	.	20,080 46
City Treasurer,	.	.	.	11,057 60
Testing cement,	.	.	.	257 82
Additional catch-basins,	.	.	.	1,584 48
Additional work on sewers,	.	.	.	1,202 74
Catch-basins in Exchange street and Exchange place,	.	.	.	671 30
" " Hope street,	.	.	.	533 06
Catch-basin in Park street,	.	.	.	144 36
" " Benefit street near Thomas street,	.	.	.	132 24
Catch-basins corner of Hopkins and South Main streets,	.	.	.	246 63
Sewer in Pine street, from Dyer to Hay street,	.	.	.	817 06
" " Pearl street, from Beacon to Plane street,	.	.	.	7,068 33
" " Plane and Blackstone streets,	.	.	.	26,803 47
" " Arch and Greenwich streets,	.	.	.	2,850 52
" " Pond street, from near Winter to Pearl street,	.	.	.	1,722 45
Amount carried forward,	.	.	.	\$138,320 33

REPORT ON SEWERS.

15

Amount brought forward, . . .	\$133,320 33
Sewer across High street, through private property to Woonasquatucket river, . . .	3,127 77
Sewer in Tower street, from Atwell's avenue to Federal street, . . .	935 19
Sewer in Elbow street, from Hospital to Chestnut street, . . .	1,223 22
" " Lester street, from D to Bridgham street, . . .	331 93
" " Benevolent street, from Hope to Brook street, . . .	1,728 55
" " Friendship street, from near Richmond to Dor rance street, . . .	3,857 65
Sewer in Power street, from near Brown to Brook street, . . .	2,907 65
" " Charles street, from Randall square to Orms street, . . .	1,020 12
" " Dorrance and Cove streets, . . .	14,151 26
" " Providence street, from Lockwood to Pearl street, . . .	880 49
" " Blackstone street, extension to Allen's avenue, . . .	23 10
" " Hayward street, from Portland to Pearl street, . . .	1,111 50
" " Sheldon street, from near Benefit to Brook street, . . .	1,290 19
" " Richmond street, from Clifford to Friendship street, . . .	415 85
Sewer in Brook street, from Meeting to Angell street, . . .	1,624 41
" " Cranston street, from Winter to Pearl street, . . .	412 68
" " Dean and Washington streets, . . .	712 68
" " Friendship, West Friendship and Dudley streets, . . .	1,548 64
" " Pallas street, from Vernon to Carpenter street, . . .	194 89
Completed sewers, . . .	762,264 47
John Gillen, . . .	15 30
R. G. Walmsley, . . .	47 52
G. W. Rader & Co., . . .	59 18
Engineering department, for horse hire, . . .	2,062 35
" " " for books, stationery, etc., . . .	198 00
" " " for printing, . . .	624 80
" " " for instruments, . . .	196 19
" " " for sundries, . . .	68 34
Superintendence of cleaning and repairs, . . .	8,391 55
Cleaning catch-basins and sewers, . . .	20,715 22
Cleaning and repairing old sewers, . . .	8,115 83
Repairing new sewers, . . .	4,100 90
Alterations caused by change of grades, . . .	1,412 45
	<hr/>
	\$979,088 20

CR.

J. W. & J. J. Newman, for Ship and Dyer streets, . . .	\$128 95
Leach & Co., for Atwell's avenue, from Acorn to Dean street, . . .	65 00
Patrick Smith, for Pond street, from near Winter to Pearl street, . . .	25 69
Akron Sewer Pipe Association, . . .	10 50
Approved bills, . . .	978,858 08
	<hr/>
	\$979,088 20

TRIAL BALANCE OF LEDGER, COMMITTEES APPOINTED BY THE BOARD
OF ALDERMEN, TO CONSTRUCT CERTAIN SEWERS, AUGUST 31, 1876.

DR.

Approved bills, \$391,905 72

CR.

Thomas Newman, for Pearl street, from Broad to Mum-
ford street, \$1,500 36

Approved bills, 390,315 36
\$391,905 72

RECEIVED BY THE BOARD OF WATER COMMISSIONERS, SEWER DEPART-
MENT, FROM JUNE 1, 1876, TO AUGUST 31, 1876, INCLUSIVE, AND PAID TO
THE CITY TREASURER.

1876.

June	1.	Of Union Railroad Co., for labor and materials, . . .	\$4 53
	2.	Of Mrs. Rebecca B. Danforth, for labor, cleaning cistern, . .	6 00
	3.	Of George H. Read, for stones from Brook street sewer, . .	35 00
	8.	Of Commissioners for new Rhode Island State Prison, for testing cement,	51 00
	14.	Of Rufus Read, for labor cleaning private connection, . .	2 00
	19.	Of Fuller Iron Works, for scrap iron,	23 62
	29.	Of Henry G. Dennis, for old junk,	1 00
July	1.	Of Davis G. Hopkins, for labor and materials, cleaning private connection,	19 70
	6.	Of City of Concord, N. H., for invert blocks,	256 00
	17.	Of H. A. Carson, for galvanized tin bucket,	9 00
	20.	Of S. Grant & Co., for testing cement,	1 00
Aug.	10.	Of Charles N. Harrington, for labor cleaning private con- nection,	2 00
	14.	Of Thomas Thorp, for sand,	10 00
		Of Allen's Print Works, for use of pulsometer pump, . .	25 00
	23.	Of Sylvester Taylor, for earth,	4 45
	31.	Of H. A. Carson, for old rope and old iron,	11 90
		For labor filling cisterns, boilers, tanks, etc., with Pawtuxet water,	189 50
			<u>\$651 69</u>

627209P

1882.]

CITY DOCUMENT.

[No. 21.]

Providence, R.I., March 1882.

REPORT

OF THE

CITY ENGINEER

SUBMITTING A PLAN FOR THE
DRAINAGE OF A PORTION
OF THE EIGHTH AND
NINTH WARDS.



PROVIDENCE :
PROVIDENCE PRESS CO., PRINTERS TO THE CITY,
1882.

Accession.

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THE CITY OF PROVIDENCE.

REPORT OF THE CITY ENGINEER SUBMITTING A PLAN FOR THE DRAINAGE OF A PORTION OF THE EIGHTH AND NINTH WARDS.

CITY ENGINEER'S OFFICE. CITY HALL, }
PROVIDENCE, R. I., June 1, 1882. }

TO THE HONORABLE THE CITY COUNCIL OF THE CITY OF
PROVIDENCE :

Agreeable to resolution No. 102, approved March 14, 1882, directing the city engineer "to report to the city council, in print, a plan for the drainage of that portion of the city lying partly in the eighth and partly in the ninth wards, draining into Long, Mashapaug and Cunliff's ponds, and also towards Corliss cove," and in pursuance, also, to other resolutions, asking for plans for the drainage of portions of the ninth ward, the accompanying plan is presented :

The area to be drained, as represented in colors on the map, is about 1,900 acres, (not including the park, which is 64

acres,) and is bounded on the east by the Pearl street district, from Division street on Bridgham street to O'Connell street on Eddy street, by Eddy street Providence Harbor and a part of Narragansett Bay; on the west by Benedict pond district, from Willow street to Cranston street and by Fenner avenue and Mashapaug pond, and extending from Dexter street at High street on the north to the Cranston line on the south.

The object to be accomplished ultimately, is the collection of the drainage from all the district into one main sewer to be discharged at or near tide water at Field's Point.

For this purpose it is designed to lay a main sewer, starting at High street on Dexter street and running southerly through Dexter street to Cromwell street; thence southwesterly by the westerly side of Long Pond to Potter's avenue at Crocker avenue; thence through Crocker avenue to the south side of the New York, Boston and Providence Railroad, receiving branches at Huntington avenue which drain 56 acres, also being joined at Burrington street by a branch draining the area south of the railroad and between Fenner avenue and Mashapaug pond, containing 74.3 acres. Thence the main follows the south side of the railroad, being joined by a branch at Earle street which drains 16.9 acres, to Bartlett street extended; at this point a branch is received from Narragansett avenue draining about 84. acres; thence crossing the railroad and running through Bartlett street to Cobden street, at Elmwood avenue being joined by a branch draining Elmwood avenue from Earle street, and at Cobden street being again joined by a branch draining a territory covering 218.7 acres; thence through Cobden street and Roger Williams avenue to Hamilton street as platted; near here, a branch joins the main from the right which will drain part of the park and land lying adjacent; thence running easterly, following the north side of the railroad to Plain street, receiving a branch at Niagara street that drains an area of 67.9 acres; at Plain street the main is joined by a branch coming through an extension of Ocean street, which drains the territory lying between Eddy

and Broad streets and south of Peace and Public streets ; thence crossing the railroad and Aldrich street and passing under Eddy street, at each of which streets a branch is received ; the line then runs easterly by the head of Corliss cove and through the natural depression in the hills to the shore just north of the small pox hospital ; thence by the shore line and inside of the harbor line, crossing Field's Point to tide water.

The accompanying contour map will explain itself better than a written description can. It shows the proposed location of the main sewer, the division as to districts, and the disposition of the sewers in the same, also the areas of the principal districts and at points on the line of the main sewer. Contour lines represent continuous elevation above mean high water. Where new streets are proposed they are shown by dotted lines.

Your attention is called to several important points, principally in regard to those places where it will be necessary to lay out new streets and extend those already laid out. Existing or platted streets have been followed as far as possible and new ones suggested only where the attainment of the best results seemed to require it.

To begin at the upper end of the line : at the corner of Cromwell and Dexter streets the surface drainage of 99.1 acres concentrates and now runs into Long pond ; to this point, also, the sewage of the same area will be brought and a new street is required, located either through or by the side of the pond, running to the low point on Potter's avenue at Crocker avenue. The location and grade of this proposed street should be determined upon and made the basis upon which to locate and grade the streets on either side ; the grade of this street should also be a continuous down grade, however slight.

Moore street extended westerly from Bucklin street seems to be the best outlet for Peace, Whitmarsh, Henry and Moore streets west of Greenwich street, and a part of Bucklin street.

The streets leading off of Potter's avenue to the southwest,

between and including Cranston street and Madison street, all grade toward the railroad, requiring and intercepting street to prevent the water from running on to the railroad.

Huntington avenue, so far as laid out, is in the right location and if extended westerly to Cranston street and easterly to the corner of Carter and Vineyard streets, grading each way to Crocker avenue, will give an outlet for an area of about 56 acres. The area concentrating at the corner of Crocker avenue and Burrington street is 413.8 acres; from this point to the point where Bartlett street extended will cross the railroad, a street or right of way should be laid out by the side of the railroad location, as this is the best line to follow.

Bartlett street will need to be laid out from Elmwood avenue to the railroad. On the extension of the line of this street west of the railroad to Narragansett avenue, the drainage from about 84 acres can be taken, provided the territory west of the railroad is properly platted and graded.

At Cobden street quite a large and important district containing 218.7 acres has its outlet.

The district begins as far north as Lawrence street on Greenwich street and covers the area concentrating at Daboll street and Greenwich street, forming what is known as "Daboll's pond," which received the drainage of 25.5 acres.

This point has been temporarily relieved by a surface drain, but for a permanent relief, it is proposed to extend Hamilton street from Potter's avenue to Daboll street, and grade Daboll street from Greenwich street to Hamilton street extension, thus giving a surface outlet for the water collecting here.

Udike street should be extended to Plenty street to give good drainage to Plenty and Peace streets.

Hamilton street as far south as Irving street is taken for the line of the main for this district, requiring as it does the least new lay-out to give an outlet, and on the whole following nearest to the average valley line.

Irving street will have to be extended to Melrose street, which should be extended to meet Cobden street at Sackett

street. It will be seen that these streets are in the line of what was evidently intended as a future lay-out.

The drainage from an area of about 119 acres from the south joins the main line near Hamilton street; part of this area is in the park, and the rest lies south of the park and north of Cunliff's pond; this tract is not graded, and the summit line has been assumed allowing that the streets will be so graded as to take to Broad street all the area possible. The only outlet for the rest is through the park as shown.

Emerson street should be extended southerly to Sackett street, and Early, Sassafras, Campbell, and Byfield streets to Niagara street. The area taken through Niagara street to the main is 67.9 acres.

From the corner of Roger Williams avenue and Hamilton street to Plain street, it is proposed to take a strip of land on the north side of the railroad location, of sufficient width to allow of being excavated, if thought best, to such a depth as will furnish a surface outlet for the water. From this point to Colwell street, at a point in the line of Ocean street extended, and thence to Ocean street at Thurber's avenue, a new street should be laid out as an outlet for Ocean street, and also for the district discharging through Colwell street.

This last district, containing about 150.8 acres, extends northerly to the corner of Broad and Clinton streets.

At Broad and Public streets, the arrangement of the present grades make a basin of about 18.0 acres. The shortest way out for this is through Public street, easterly. The grade of Public street between Broad street and Prairie avenue, is so established as to leave a low point between said streets, and a street should be laid out from Public street southerly to Colfax street on a line half-way between Baker street and California street. This street fairly represents the valley line to which will be graded the streets between Broad street and Prairie avenue and is the only outlet for this area. The drainage of Plain street and Eddy street is brought to the main sewer at the railroad. Plain street will probably cross over the railroad.

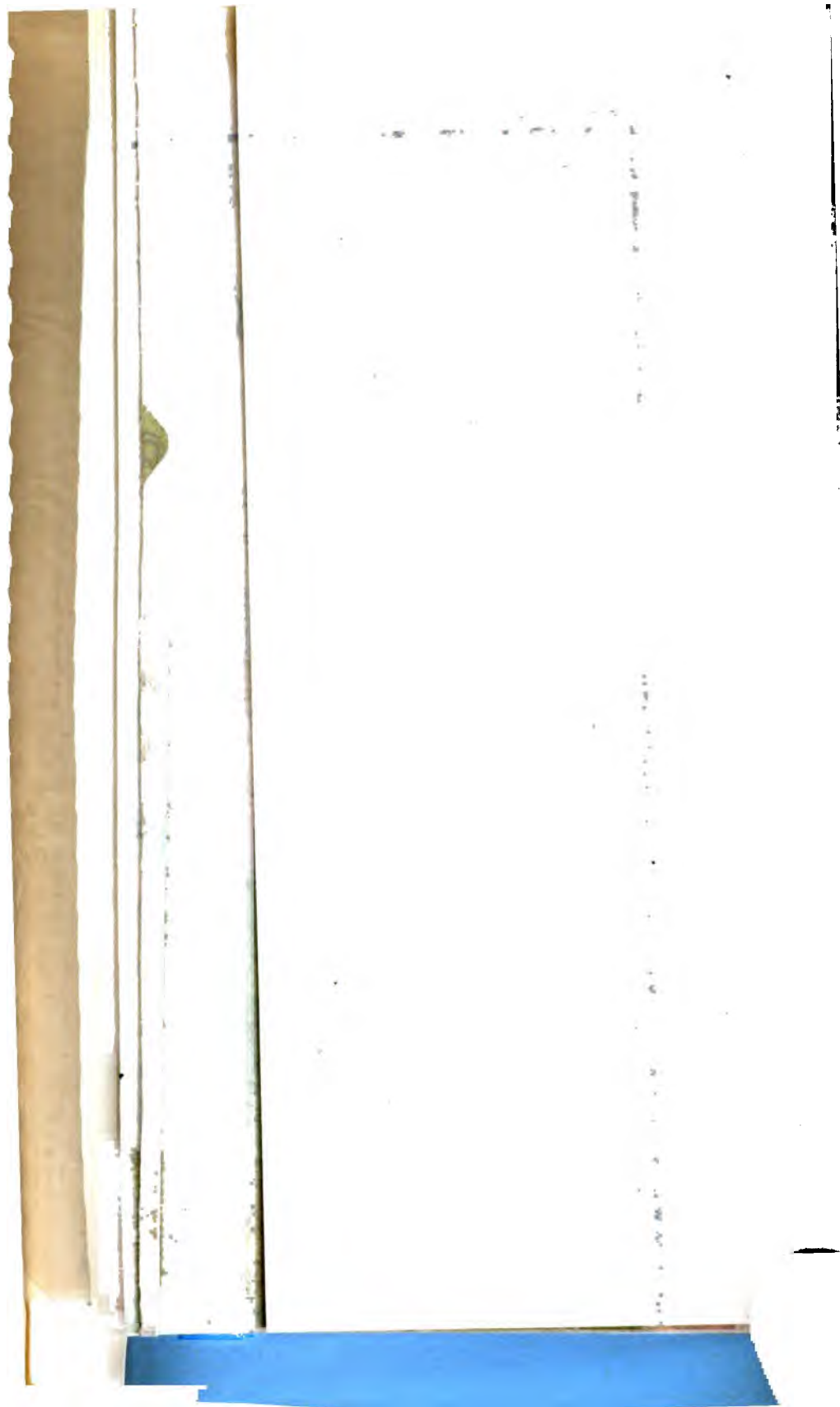
Pavilion avenue can easily be graded to pass under Plain street to Ocean street, extended.

Early street should be extended from Broad street to Prairie avenue to give a surface outlet for the water which now collects at that point on Broad street. The total area coming to the main sewer at Plain street and the railroad is 309.2 acres ; from here a new street should be laid out for the main, crossing the railroad and Plain street at the same time, and passing under Aldrich street and Eddy street, about on the line as indicated on the map. An area of 17.9 acres is brought through Aldrich street, and of 67.1 acres through Eddy street from the south. This district extends to Fourth street off of Broad street and to a point nearly opposite on Eddy street.

The area east of Eddy street and south of the railroad and Corliss cove consisting of about 385 acres, is a very uneven tract, and as yet but a portion of it has been platted and none of it graded ; the main as shown is located over what will be the best line with reference to the natural lay of the ground. The territory to be properly laid out should be considered as a whole. The platting of this territory may affect the location of that portion of the main lying between Eddy street and the outlet.

Respectfully submitted,

SAMUEL M. GRAY,
City Engineer.



1883.]

CITY DOCUMENT.

[No. 21.]

REPORT
UPON A
SYSTEM OF SEWERAGE

FOR THE
MOSHASSUCK AND WEST RIVER
DRAINAGE DISTRICTS.

[PRESENTED BY THE CITY ENGINEER, OCTOBER 1, 1883.]



PROVIDENCE :
PRINTED BY THE PROVIDENCE PRESS COMPANY.
1883.

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CITY DOCUMENT.

[No. 21.]

REPORT UPON A SYSTEM OF SEWERAGE

FOR THE
MOSHASSUCK AND WEST RIVER
DRAINAGE DISTRICTS.

[PRESENTED BY THE CITY ENGINEER, OCTOBER 1, 1883.]



PROVIDENCE :
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Providence, R. I. - City Engineer's Office

1883.]

CITY DOCUMENT.

[No. 21.]

REPORT

UPON A

SYSTEM OF SEWERAGE

FOR THE

MOSHASSUCK AND WEST RIVER
DRAINAGE DISTRICTS.

[PRESENTED BY THE CITY ENGINEER, OCTOBER 1, 1883.]



PROVIDENCE :
PRINTED BY THE PROVIDENCE PRESS COMPANY.
1883.

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THE CITY OF PROVIDENCE.

REPORT OF THE CITY ENGINEER ON A SYSTEM OF SEWERAGE
FOR THE MOSHASSUCK RIVER AND WEST RIVER DRAINAGE
DISTRICTS.

[Presented October 1, 1883.]

CITY ENGINEER'S OFFICE, CITY HALL, }
PROVIDENCE, R. I., October 1, 1883. }

TO THE HONORABLE THE CITY COUNCIL OF THE CITY OF
PROVIDENCE :

In accordance with resolution of the city council No. 368, approved September 15, 1882, the following report relating to the arrangement of the main sewers and laterals over that part of the city naturally draining into the Moshassuck river and its branch, the West river, as shown by the accompanying plan is presented.

These rivers have their sources some distance north of the city line, the West river rising some $4\frac{5}{6}$ miles from the line and draining about 5,604 acres before reaching it, and

the Moshassuck river rising about $6\frac{5}{10}$ miles north of the city line and draining about 6,561 acres before crossing the line; the larger part of both of these areas will, in all probability, remain thinly settled and will not require any immediate attention.

The plan presented embraces an area of about 2,500 acres, 980 acres of which drain into the Moshassuck river above the Cove Basin, and 1,320 acres drain into the West river.

That part of the Moshassuck river valley lying within the limits of the town of Pawtucket has no means of outlet except through the city of Providence; parts of this area are destined to be quite thickly settled, in fact are already being built upon, and the question of the disposal of its sewage will have to be considered in connection with the areas lying within the city limits, in the determination of the sizes of main sewers, sewage works, etc.; the line of main sewer is therefore shown as crossing the city line.

The district covered by this report is bounded in general terms as follows, viz.: On the east, starting from Fox Point, by the Brook street district and East avenue to the city line; on the north and west by Pawtucket and North Providence to near Smith street; on the south by an irregular line between Smith street and Admiral street to the summit of Bradley's Hill; thence by Eaton street, Douglas avenue, Orms street, Washburne street, and Smith street, to the Moshassuck river and by the river and water front to Fox Point.

The intercepting main sewer for this district commences at the corner of India and South Water streets, at the junction with the main intercepting sewer coming from the easterly part of the city, bordering on the Seekonk river, and near the point where the united lines will probably be taken across the Providence river by a siphon; from this point it runs northerly through South Water and Canal streets to Smith street, intercepting the sewers emptying into the Providence river from the east, at Smith street, receiving

the first sewer from the west side of the line ; thence in the line of Canal street extended, and following along the east bank of the Moshassuck river to Mill street ; thence through Bark street to a point just above the Snow and Lewis dam, where the line turns and crosses under the river and into Charles street, a short distance south of Orms street ; thence through Charles street to Randall square ; at this point the line divides, one part turning to the west through Martin street and following up the West river valley, the other following the Moshassuck river valley ; the latter line will leave Charles street and turning to the right pass through the yard of the Franklin Foundry to their dam ; thence passing under the river and turning to the right into Printery street at Nash lane ; thence turning to the left, crossing the yard of the Allen Print Works, and keeping close to the east bank of the old canal to near Branch avenue ; thence passing under the river and keeping on the left or westerly side of the river to Smithfield avenue ; thence parallel with the old canal to Cemetery street ; thence following the bed of the old canal to the city line. The sewage from that part of the town of Pawtucket which must be taken through this main can easily be concentrated at or near this point.

An area of about 45 acres lying west of Smithfield avenue naturally drains to the low ground west of the railroad between Smithfield avenue and Cemetery street ; the only outlet for this area is over the surface across Cemetery street into Clark street, and through the grounds of the abattoirs, under the railroad and into the swamp. This line is the best one to follow in sewerage this area, although it involves carrying the sewers through a part of Pawtucket ; it is proposed therefore to open a street from the low point in Smithfield avenue to the low point in Cemetery street at Clark street ; from the railroad to the old canal, this line follows a platted street.

With the sewer passing directly through the abattoir grounds, all the sewage can be collected from the same,

which now pollutes the river, although in a somewhat less degree than formerly.

At Cemetery street an area of about 182 acres lying between North street, East avenue, and the city line, is brought to the main.

An area of about 124.8 acres comes in at Smithfield avenue, mostly through Northup avenue. The area bounded by the railroad and Branch avenue, the river, Burt street, and Cross street, will have to be taken under the river near Deer street. An area of 115.7 acres, bounded by Earle's lane, Pleasant street, East avenue, North street, and North Main street, joins the main at Livingston street. The sewage from Whelden street, Nash Lane, on the west, Randall street, Stevens street, and a part of Charles street and Smith street, will have to be taken under the river to the main, but it is believed without having to make use of siphons.

The West river branch of the main will run through Martin and Ashburton streets, crossing the railroad and turning when in line with Charles street; thence through Charles street to a point just beyond Leonard's pond, at an angle in Charles street; thence following the north side of the pond straight to Branch avenue, at the easterly bridge; thence in Branch avenue to Douglas avenue; thence by a new street easterly to Admiral street.

The upper end of the drainage area is a little south of where Smith street crosses the city line, between Admiral street and that point, covering an area of about 100 acres; there is no proposed lay-out, but by a proper treatment nearly all the drainage can be kept within the city limits.

At Veazie street, the sewage from 84 acres will be brought under the river to the main line. The main line will pass under the river at both bridges on Branch avenue, near Wanskuck, and also at the bridge on Charles street. It is proposed to open a street from the end of Langdon street to the proposed street for the main sewer, to facilitate the align-

ments. An area of about 74 acres will come to the main at Hawkins street. An area of about 98.6 acres is brought to the main sewer through Admiral street, also at Webster street an area of about 197.8 acres is received coming through Oregon street.

Special attention is called to the several points where new streets are proposed for the relief of certain areas.

From Douglas avenue at Branch avenue to Admiral street, an area of about 186.8 acres is given an outlet by laying out a street. The new street as shown from the easterly bridge on Branch avenue, runs close by the edge of the pond to Charles street, keeping low enough to prevent an extraordinary amount of cutting, and owing to better grades, will be a great improvement for teaming, as well as for sewerage purposes.

From the junction of Webster street and the railroad track to the corner of Oregon and Borva streets, a new street is proposed, giving an outlet for the area coming through Oregon street. The lay-out in this vicinity may be changed considerably, and is dependent on the final settlement of the railroad "Terminal Facilities" problem.

A street is proposed starting at Northup avenue and running north near to and parallel with the railroad to the valley line, thence to the left, crossing Ledge street and Jasper street at the low points in each to the low point in Cook avenue, thus giving a surface outlet for the area draining on to them, and also obviating the necessity for maintaining a culvert under the railroad, which at present is the only means of outlet.

Mention has already been made of the proposed location, and the necessity for a street from Smithfield avenue to Cemetery street.

All river crossings on the plan can probably be made without the use of siphons.

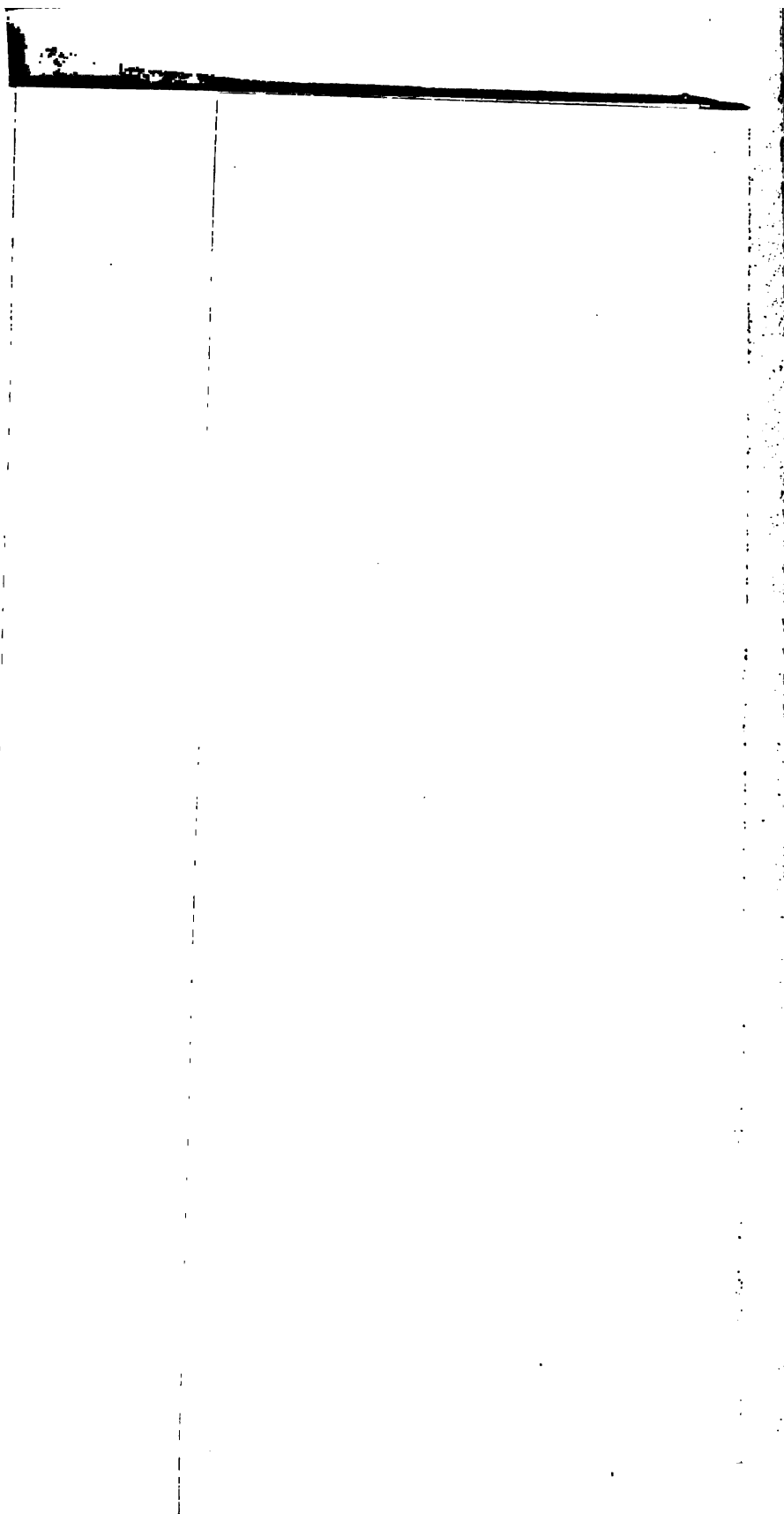
The large amount of area as yet not platted, renders it difficult in some cases to determine the best lines, but slight

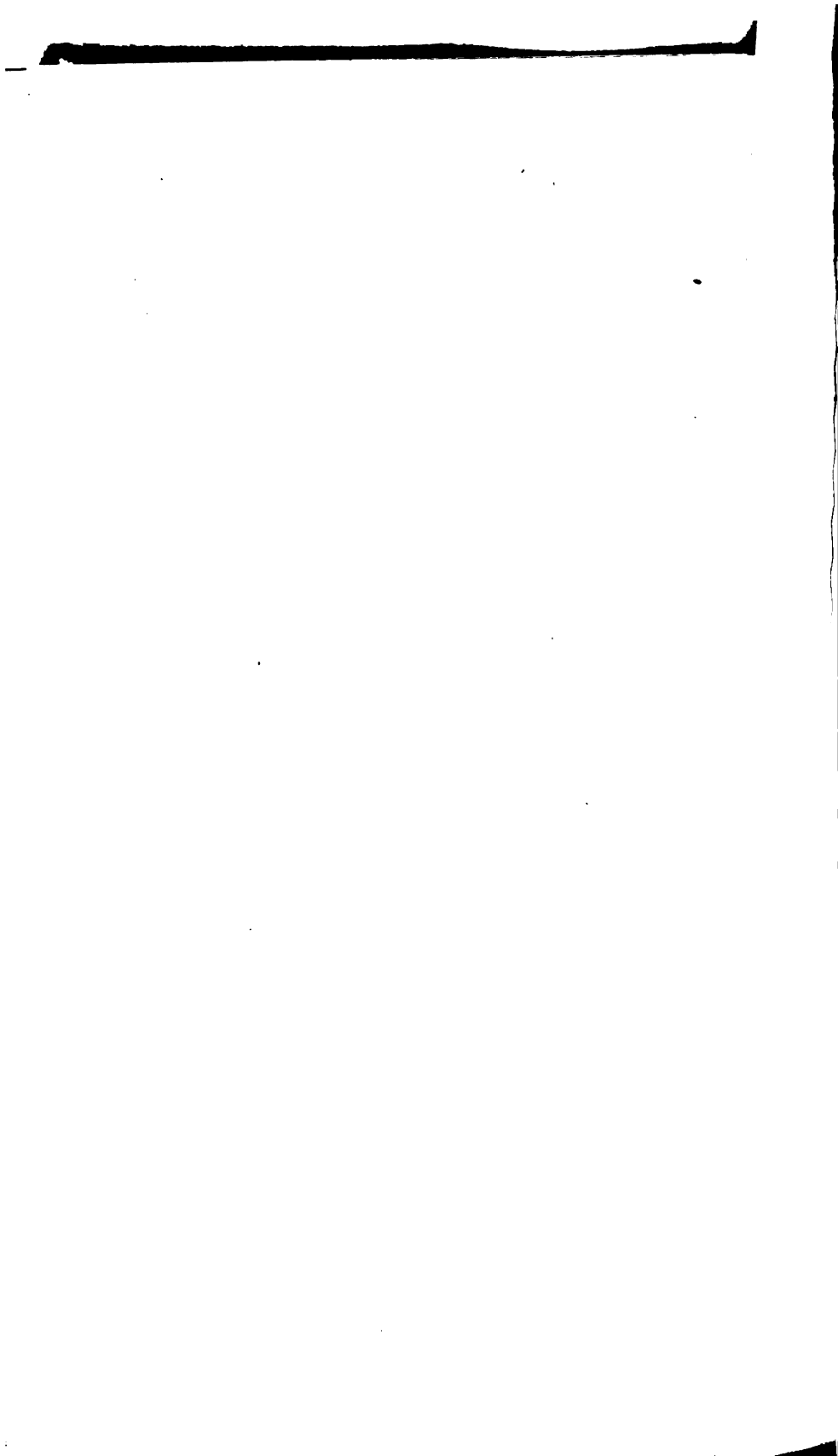
changes will no doubt be made to accommodate lay-outs that cannot be foreseen.

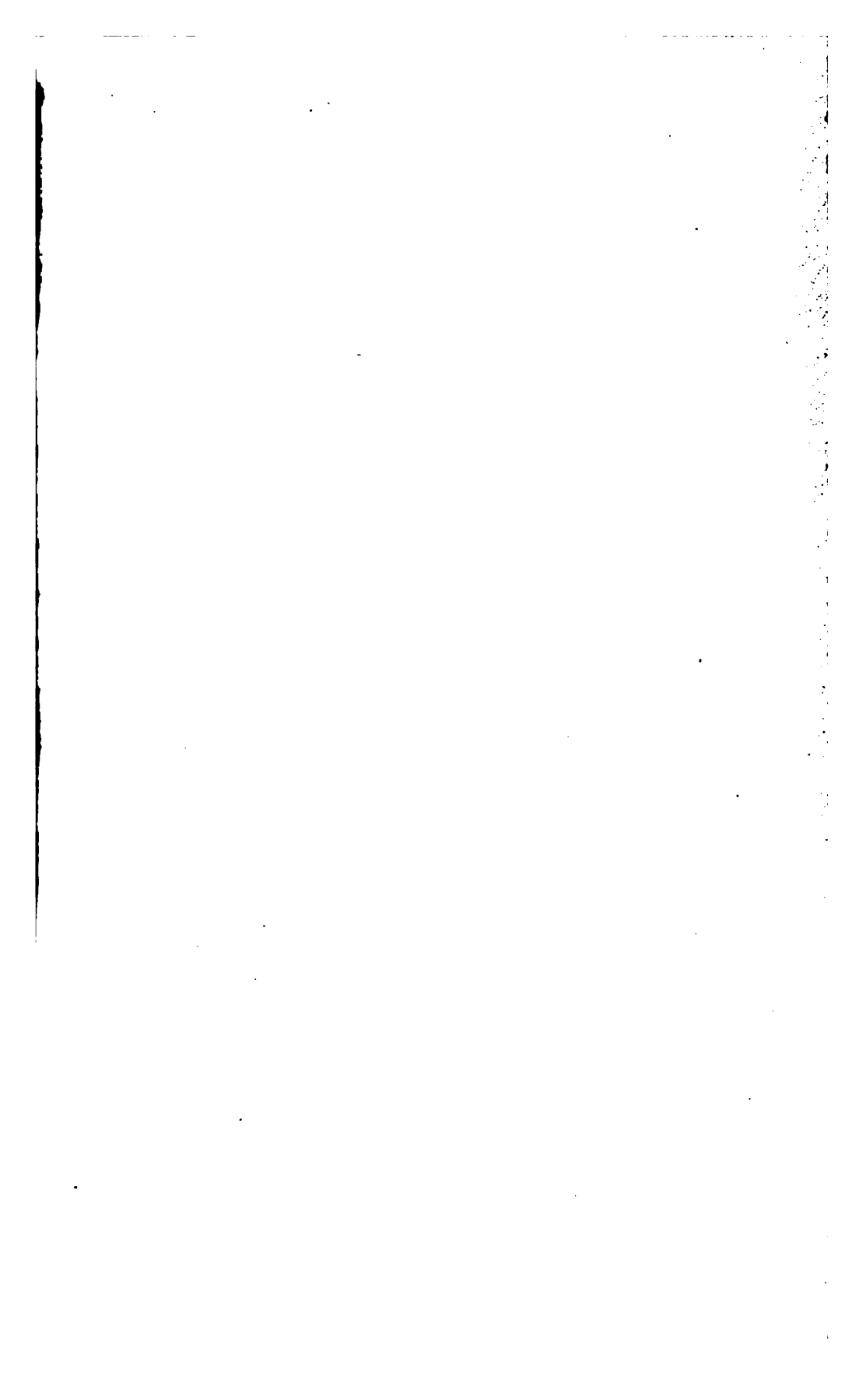
The close proximity of each of the main branches to the rivers will make it easy to arrange for overflows, and thus make the size of the mains much smaller than could otherwise be done.

Respectfully submitted,

SAMUEL M. GRAY,
City Engineer.









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1883.

CITY DOCUMENT.

[No. 24.]

REPORT

OF THE

JOINT STANDING COMMITTEE ON THE
CITY ENGINEER'S DEPARTMENT

IN RELATION TO THE

POLLUTION

OF THE

Tributaries of the Providence River.

[Presented December 17, 1883.]



PROVIDENCE:

PROVIDENCE PRESS COMPANY, CITY PRINTERS.

1883.

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Subject.

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Beside the main topic this book also treats of

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1883.

CITY DOCUMENT.

[No. 24.]

Providence, R.I.
REPORT

OF THE

**JOINT STANDING COMMITTEE ON THE
CITY ENGINEER'S DEPARTMENT**

IN RELATION TO THE

POLLUTION

OF THE

Tributaries of the Providence River.

[Presented December 17, 1883.]



PROVIDENCE :

**PROVIDENCE PRESS COMPANY, CITY PRINTERS.
1883.**

REPORT.

TO THE HONORABLE THE CITY COUNCIL OF THE CITY OF PROVIDENCE :

The undersigned, joint standing committee on the City Engineer's department, respectfully present the following report upon certain matters referred to us in connection with the Providence river and Cove basin.

The business was brought before us by reason of the following resolutions, petition and message.

"RESOLUTIONS passed by the Providence Board of Trade at its monthly meeting, held May 1, 1883.

"*Resolved*, That this Board of Trade, in view of the present state of the waters of Providence river and Cove basin, deem it essential for the preservation of the health of our city, that immediate steps should be taken to provide a better system of sewerage.

"*Resolved*, That the above resolution be submitted to the city government, and that the president of this board be directed to prepare a memorial for the signature of the tax payers of the city, to be presented to the city council.

"I hereby certify this to be a true copy of the records.

"(Signed)

F. P. LITTLE, Sec'y."

PETITION.

"*To His Honor the Mayor, and to the City Council of the City of Providence :*

"The undersigned, citizens of Providence and tax payers therein, respectfully represent that the sewage at the present time permitted to flow into the Cove basin, and the waters of Providence river above Fox point, has become very offensive to the comfort and dangerous to the health of our people; that the evil will increase in magnitude and become more troublesome as the population of the city increases; and that means should at once be devised to remedy so serious a nuisance.

"Therefore they pray that you will take this matter into consideration and do, at an early day, whatever may be necessary to relieve the city from this growing source of danger."

"(Signed by 68 citizens of Providence.)"

MESSAGE.

"CITY OF PROVIDENCE,
"EXECUTIVE DEPARTMENT, CITY HALL, }
"June 18, 1883.

"Gentlemen of the City Council:

"I have received from Charles H. Merriman, Esq., president of the board of trade, and transmit herewith a copy of resolutions passed by the board, and a memorial, bearing the signatures of many of our well known citizens and tax payers, urging upon the city council the importance, for the health and comfort of the city, of early action in relation to the sewage permitted to flow into the waters of the Cove and the Providence river above Fox point.

"This deliberate expression of the opinion of the board of trade, comprising in its membership, as it does, so large a number of the intelligent business men of this city will serve as an endorsement of the action already taken by the city council, looking to a remedy of the evils complained of, and an assurance that the early prosecution of such measures for the disposition of the sewage of the city as may be demanded for the preservation of the health of the community, although necessarily involving a large expenditure of money meets with general approval.

"(Signed)

WILLIAM S. HAYWARD,

"Mayor."

THIS SUBJECT HAS BEEN EXAMINED BEFORE.

You are doubtless aware that the subject referred to us is no new one. On the 27th of July, 1876, Dr. Edwin M. Snow, superintendent of health, presented to the board of aldermen a communication in relation to the foul condition of the waters of the Moshassuck river.

This report was not printed, but it called attention to the need of measures to prevent the continuance of the pollution then practiced.

Again on November 22, 1877, Dr. Snow presented another report (City Document of 1877, No. 33.) upon the water in the Moshassuck river. In this report Dr. Snow makes the following declaration :

"In view of the whole subject I give my opinion unhesitatingly that the water in the Moshassuck river, before it reaches the limits of the city—and of course when entirely

beyond the control of the city government—is rendered so impure that it is utterly unfit for domestic use and is a constant source of nuisance and danger to public health.

"After the river reaches the city limits it receives the filthy waste and other offensive matters from another large woolen manufactory and another large bleachery on West river, from a very extensive print works, from several large manufactories of different kinds, from numerous privies on the banks of the river, and also receives a very large and rapidly increasing amount of sewage. In fact the river, in its course within the city and especially after it passes the print works, can be looked upon only as an open sewer, and the time is rapidly approaching when it must be treated as such and must be covered or the filth must be kept out of it.

* * * * *

"I would, therefore, earnestly recommend that a commission be appointed by the city council to urge upon the General Assembly such legislation as shall thoroughly remove the present difficulties and effectually prevent their recurrence in the future."

To the report is appended one by Professor John H. Appleton, of Brown University, giving the results of analyses of several samples of water from the Moshassuck river, all of them showing unquestioned evidences of the pollution of this stream. We reprint this report in full.

PROFESSOR APPLETONS REPORT.

"PROVIDENCE, R. I., August 29, 1877.

"EDWIN M. SNOW, M. D., SUPERINTENDENT OF HEALTH :—

"DEAR SIR :—I herewith hand you a table showing the result of five analyses of Water, tested at your request.

"Samples 1, 2 and 3 were received from you. They were marked as taken on July 26, 1877. I request you to enter in the table their proper designations. Samples 4 and 5 were taken by myself, in your presence on August 22, 1877.

" Sample 4 shows the condition of the Moshassuck river at the date referred to. It is excellent river water,—the results showing it to be but slightly inferior in quality to Pawtuxet water at Pettaconsett.

" The other samples show distinctly that the river has suffered serious pollution. These samples indicate that large quantities of mineral and organic matters have been poured into the river.

" TABLE.

" Showing results of water-analyses. The numbers represent parts (*by weight*) per million parts of water (*by weight*).

LOCATION, ETC.	Total Residue.	Organic and Volatile Matter.	Mineral Matter.	Common Salt.	Albuminoid Ammonia.	Ready-formed Ammonia.
1.	A.	B.	C.	D.	E.	F.
<i>Below Slaughter Houses, On bridge over river on Power road or Cemetery street.....</i>	238.	94.	144.	23.64	2.50	4.50
2.						
<i>In Catholic Burying Ground, Between Slaughter Houses and Darling's Works and Woolen Mill.....</i>	264.	120.	144.	26.79	2.00	12.00
3.						
<i>Above Mineral Spring Avenue and below Sayles' Bleachery...</i>	306.	114.	192.	29.16	1.30	0.10
4.						
<i>Above Sayles' Bleachery.....</i>	54.	28.	31.	5.52	.38	0.04
5.						
<i>Same as number 3, different date Below Sayles' Bleachery.....</i>	240.	88.	152.	18.91	1.20	0.15

" I will add a few words of explanation of the foregoing table, even at the risk of repeating some explanations already given you in a previous communication.

"(A.) What is described as *total residue*, is all the solid matter obtained when the water sample is carefully evaporated to dryness in a platinum dish.

"(B.) The *organic and volatile matter*, is that which is burned and expelled when the total solids are heated to a red heat.

"(C.) The *mineral matter* is that which remains unburned and unvolatized by the heating just described.

"(D.) The *common salt* is calculated from the amount of chlorine found in the water.

"(E.) *Albuminoid ammonia* is the ammonia that is formed by the artificial decomposition of certain animal matters, more or less analogous to albumen. A few nitrogenous vegetable matters yield the same product.

"(F.) *Ready-formed ammonia*, is ammonia that is expelled by simply boiling the water with pure carbonate of soda.

"The amount of albuminoid ammonia and of ready-formed ammonia in a water, is at present almost universally taken as the best chemical measure of the amount of animal contamination that the sample of water has suffered.

"I have therefore spoken of the meaning of the *terms* employed in the table. I will now refer to the interpretation of the *numbers* used. For the purpose of comparison, I give here a statement of the result of a recent analysis of the Pawtuxet river water at Pettaconsett :

LOCATION, ETC., AND DATE.	Total Residue.	Organic and Volatile Matter.	Mineral Matter.	Common Salt.	Albuminoid Ammonia.	Ready formed Ammonia.
August 15, 1877.	.	.	.	.	.	.
Pawtuxet river.	48.	24.	24.	6.30	0.28	0.10

"By reference to the table, it appears that the samples there described had, as compared with the Pawtuxet river water, as follows :

"Of Total Residue,

- No. 1, had about 5 times as much as Pawtuxet.
- No. 2, had about $5\frac{1}{2}$ times as much as Pawtuxet.
- No. 3, had about $6\frac{1}{2}$ times as much as Pawtuxet.
- No. 5, had about 5 times as much as Pawtuxet.

"Of Organic and Volatile Matter,

- No. 1, had about 4 times as much as Pawtuxet.
- No. 2, had about 5 times as much as Pawtuxet.
- No. 3, had about $4\frac{1}{2}$ times as much as Pawtuxet.
- No. 5, had about $3\frac{1}{2}$ times as much as Pawtuxet.

"Of Mineral Matters,

- No. 1, had about 6 times as much as Pawtuxet.
- No. 2, had about 6 times as much as Pawtuxet.
- No. 3, had about $8\frac{1}{2}$ times as much as Pawtuxet.
- No. 5, had about $6\frac{1}{2}$ times as much as Pawtuxet.

"Of Common Salt,

- No. 1, had about 4 times as much as Pawtuxet.
- No. 2, had about $4\frac{1}{2}$ times as much as Pawtuxet.
- No. 3, had about 5 times as much as Pawtuxet.
- No. 5, had about 3 times as much as Pawtuxet.

"Of Albuminoid Ammonia,

- No. 1, had about 9 times as much as Pawtuxet.
- No. 2, had about 7 times as much as Pawtuxet.
- No. 3, had about $4\frac{1}{2}$ times as much as Pawtuxet.
- No. 5, had about $4\frac{1}{2}$ times as much as Pawtuxet.

"Of Ready-Formed Ammonia,

No. 1, had about 45 times as much as Pawtuxet.

No. 2, had about 120 times as much as Pawtuxet.

No. 3, had about 1 times as much as Pawtuxet.

No. 5, had about 14 times as much as Pawtuxet.

"I need not add any remarks to these striking figures.

"Yours respectfully,

"JOHN H. APPLETON."

The quotations here presented are but meagre extracts from an intelligent and decided report, to the whole of which we respectfully call careful attention.

The pollution of the Moshassuck river is the subject of still another report presented by Dr. Snow to the Board of Aldermen, Oct. 23rd, 1878. (City Document of 1878, No. 30). We call attention to the whole of this report also, and particularly to the following extracts.

"There can be no doubt that the whole of both rivers—the West and the Moshassuck—above Allen's Print Works, and still worse the Moshassuck below the Print Works,—are causes to some extent of sickness, disease and death to the public."

* * * * *

"Nearly a year since I presented a report to your Board upon the impurities of the Moshassuck river, and urged immediate action. The report was printed, but no action was taken. There can be no doubt in the minds of any one that the Moshassuck river before it enters the city, is in a very filthy condition, and that after it enters the city the amount of filth is enormously increased by manufactories within the city limits. When to these sources of filth we add the rapidly increasing amount of sewage that is turned into the river we ought not to be surprised that the river at the

Weybosset bridge has become extremely filthy and at times very offensive to sight and smell. Of course it must be more or less injurious to health, though there are counter-acting causes that remove the danger in some degree.

"The Woonasquatucket river is, in some respects, in a similar condition to the Moshassuck, though not yet as bad.

"There are two important measures that require the early attention of the city government,—in fact that are imperatively demanded in the interest of the public health.

"The first is that which I urged a year since, to obtain action through the General Assembly to prevent pollution of the streams by manufactories throughout the state. This subject is exciting much attention in other states and most valuable information has been recently printed in relation to it, especially in Massachusetts. It is a subject in which the manufacturers are interested as well as the public, as at the present time the manufacturer who is located farthest up stream seems to enjoy the right to ruin the water for the use of all below him. The city is especially interested in the subject as two mill streams are flowing through it and another supplies us with drinking water.

"The second measure of immediate importance is the construction of intercepting sewers to receive all the sewage of the city and carry it down to Sassafras point or beyond. This was, and is, a part of the system of sewerage upon which the city has entered, which was known to be an absolute necessity from the beginning, and the construction of which was made imperative by the introduction of the Pawtuxet water. As then, its importance and positive necessity are universally conceded, it would seem to be the part of wisdom to make preparations for commencing the work at as early a day as possible."

WORK OF THE COMMITTEE.

As a committee we have held several meetings, and have devoted considerable time to the matter referred to us.

We find that the rivers emptying into the Cove basin are the Woonasquatucket river and the Moshassuck river. At a point about one and three-eighths miles from the Cove basin another river, called the West river, empties into the Moshassuck, and so eventually into the Cove itself.

We have made a careful examination of the Cove, the rivers flowing into it, and of such sources of pollution of them as we have been able to detect.

Your committee have also made a careful inspection of the Providence river underneath the bridges, between the Cove basin and the Crawford street bridge. Further, we made an examination of it at the sewer outlets on both sides of the river.

The slimy scum, having an oily appearance, seen in the vicinity of the Providence Gas Company's wharf, led your committee to believe that much offensive and impure material finds its way into the river from that establishment.

We have consulted Dr. Edwin M. Snow, Superintendent of Health, Mr. Samuel M. Gray, City Engineer, and Professor John H. Appleton of Brown University, with respect to matters treated in this report, and moreover, by invitation of the committee, these gentlemen personally attended us in most of our inspections.

In order to obtain fuller information than that gained by mere inspection of the river, and the nuisances themselves, the committee called upon Professor Appleton, to make chemical examinations of certain of the samples of water collected by us.

Professor Appleton's report is herewith appended. No one can doubt that the results therein shown, point clearly to the fact that the waters of Moshassuck river, West river, and Woonasquatucket river, are defiled to an enormous degree by the manufacturing establishments located on their banks.

As your committee, we now proceed to state the results of our investigations. In doing so we shall pursue the following course: Describing the rivers in turn, and beginning at the Cove basin and following each river towards its source, we shall proceed to a point upon each where the waters appear to be flowing in a comparatively pure and unpolluted condition. We shall mention one by one the sources of pollution detected. It will be seen that, in order to make it more convenient to refer to the points inspected, we have numbered them. Some of these points are described with less fullness than others because we were not able, in all cases, to gain as complete information as might be desired. In fact these examinations have developed in us the opinion that this whole subject demands a far more extended investigation than we have been enabled to give it.

MOSHASSUCK RIVER.

The committee visited the Moshassuck river, July 26, 1883.

1st Point Inspected.

This is the mouth of the Moshassuck river as it empties into the Cove basin beneath the bridge in the Cove promenade. At this point masses of filth and garbage in the water were plainly observed by the committee. Water sample No. 1, of July 26, was taken here.

This sample of water was sent to Professor Appleton for analysis. From his report in the appendix we select certain of the numerical results and place them here in a proper juxtaposition.

TABLE.

The numbers express parts, by weight per million parts of water, by weight.

	Organic and volatile matters : including animal and vegetable matter.	Mineral matters.
Moshassuck river, pond above Sayles' bleachery.....	20.	46.
Moshassuck river, at Cove basin.	735.	4,443.

That the great increase in the amount of impurities indicates a strong defilement of the water will hardly be denied.

2nd Point Inspected.

This was Comstock's beef storehouse situated opposite Haymarket street, overhanging the river.

The committee observed that the river emitted a very bad odor at this point.

The Messrs. Comstock assured the committee that no pollution came from this business.

3rd Point Inspected.

This is Comstock's stable, connected with the beef storehouse mentioned under Point No. 2. Five horses are kept here.

The Messrs. Comstock informed the committee that no pollution came from this stable, except the urine from the horses, nothing else being allowed to run into the river.

Water sample No. 2, of July 26, was taken at 10.20 A. M., from the Moshassuck river about opposite the Central police station.

4th Point Inspected.

This is a Market, located near the Smith street bridge.

Mr. Darcy the then proprietor of the market informed the committee that the stench from the river was terrible, both at night and early in the morning. The committee observed that nearly two feet of filth and garbage matter had accumulated under the bridge.

The committee, upon examining the market, discovered that the decayed vegetables and refuse materials from it accumulated into a back cellar and apparently had thence fallen into the river.

The committee also noted that all the privy-vaults insight emptied their contents into the river.

5th Point Inspected.

The committee went down into the rear of Smith street, on land fronting on the river. They found the old Red Lion (so called), owned by Mr. G. W. Bowen, in a state of decay and neglect and contributing its share of foul odors to the immediate neighborhood.

6th Point Inspected.

Moulton & Ingraham's Planing Mill.

The committee were informed that the shavings from this mill were burned.

7th Point Inspected.

In the rear of Moulton & Ingraham's shop was found a small stable and a filthy pig-sty, both of which contributed defilement of the river.

8th Point Inspected.

The Fletcher Manufacturing Co.'s establishment.
Agent, William Ames.

Location, Mill and Charles street.*

Kind of business, manufacture of cotton braids.

The committee were informed by Mr. William Ames, manager of these works, that nothing of a deleterious nature runs from them into the river. The refuse matter from privies runs into a cess-pool.

The committee observed that some coloring matter flowed into the river, but they were informed by Mr. Ames that it was neither offensive nor injurious.

Mr. Ames said that a sewer was needed in this vicinity. He stated that the odor from the river was often excessively offensive.

9th Point Inspected.

The committee discovered that a privy from Stillman White's building emptied its contents into the river.

10th Point Inspected.

The committee also noticed that a privy belonging to the building leased by James Hanley empties its contents into the river.

11th Point Inspected.

The committee remarked that the Charles street sewer finds an outlet into the river under the bridge at Mill street.

12th Point Inspected.

Proceeding along Bark street the committee discovered that a very large number of privies and sink-drains from tenements on Charles street empty their contents into the river, and that masses of garbage and filth are piled up along the river bank.

13th Point Inspected.

Mill of The American Screw Co.

Agent, Charles T. Salisbury.

Location, Stevens street.

Kind of business, manufacture of screws, from iron, steel and brass.

Mr. Rogers, superintendent of this factory, stated to the committee that, during the spring just passed, the Screw Company had cleaned the bed of the river for the entire length of its mill. He said that the closets belonging to the mill empty into large cess-pools which are cleaned twice a year, and that none of the matter from them flows into the river; that the old drain-pipes from these closets to the river had been closed for ten years.

Water sample No. 3, of July 26, was taken from the river just above the Stevens street bridge.

14th Point Inspected.

The committee next visited the Randall street bridge, and observed that a large number of privies near by contributed their filth to the river.

15th Point Inspected.

Franklin Foundry and Machine Co.'s Works.

Agent, Mr. F. E. Sprague.

Location, Charles street.

Kind of business, manufacture of machinery and castings.

Mr. Sprague assured the committee that the privies of this establishment empty into a cess-pool, and that little, if any, filth passes into the river from it.

16th Point Inspected.

About two hundred feet south of Nash lane, and at the northern extremity of the Franklin Foundry property, the

river was found to be in a very bad state, the water being in a most putrid and filthy condition. A white scum was visible on the water from this point up to the old Nash lane bridge.

Water sample No. 4, of July 26, was taken here.

17th Point Inspected.

The next point visited was the Wheldon street bridge. The water appeared to be of a blue-black color, and was very filthy.

Water sample No. 5, of July 26, was taken at the upper end of this bridge.

This sample of water was sent to Professor Appleton for analysis. In his report in the appendix, he speaks of it as having a very offensive odor, as having a dirty brown color, as containing a brown and flaky sediment. From this report we select certain of the numerical results and place them here in comparison.

TABLE.

The numbers express parts, by weight per million parts of water, by weight.

	Organic and volatile matters: including animal and vegetable matters.	Mineral Matters.
Moshassuck river, pond <i>above</i> Sayles' bleachery.....	20.	46.
Moshassuck river, north side of Wheldon street.....	356.	522.

18th Point Inspected.

Allen's Print Works.

Treasurer, John B. Kelley.

Location, corner Thurber's lane and Branch avenue.

Kind of business, cotton bleaching and calico printing.

The water, after being used at the print works, runs by a trench into the river again. The committee found that on the premises of the print works is a large cesspool where madder, and other waste dye-stuffs, are collected, and that from time to time the liquid is allowed to run away into the river, the solid material being cleaned out and carted away.

The water-closets at the print works empty into the river.

19th Point Inspected.

This was above Allen's print works and at the junction of the West river with the Moshassuck.

The West river was found by the committee to have a black color, and to be terribly offensive and foul. The Moshassuck river was milky and also offensive.

Water sample No. 6, of July 26, from the Moshassuck river, was taken from a point about four hundred feet south of Branch bridge.

20th Point Inspected.

R. I. Tool Co.'s Works.

Treasurer, W. B. Dart.

Location, West River street.

Kind of business, manufacture of machinery.

The committee were informed that the water-closets of this establishment do not empty into the river. Further, they learned that the matters put into the river consist mainly of water used on the grindstones, and acids used on castings.

21st Point Inspected.

I. B. Mason's slaughter-houses.

The committee found that blood and other animal matters were turned into the river from this establishment, and that these substances made a sickening odor of the most offensive description at the point where the drain from the slaughter-houses empties into the swamp, whence the liquid finds its way into the river.

22nd Point Inspected.

Sayles' Bleachery.

Owners, W. F. & F. C. Sayles.

Kind of business, bleaching and finishing of cotton goods.

The committee found that most of the water-closets empty into the river.

They found that after the water is used by the Bleachery, it is run into a large cesspool, apparently with a view to giving the impurities an opportunity to settle. But when the committee examined it, the contrivance as used appeared not to be accomplishing this object. After leaving this cesspool the waste liquor flows into the river. Below the bleachery a line of planking, placed in the centre of the river, separates it lengthwise into two portions. The water from the bleach-house proper flows on the west side into the cesspool referred to, shaped like a half-circle, the radius being upwards of two hundred feet. The gate of this cesspool was found open, and polluted water pouring from it into the river at 6.25 o'clock, P. M., July 26, 1883, when the committee were there.

Water sample No. 12, of July 26, was taken from the river, below the outlet of this cesspool, and it is believed to fairly represent the condition of the river itself, below the bleachery.

This sample of water was sent to Professor Appleton for analysis. In his report in the appendix, he speaks of it as

very turbid and dirty, giving out an exceeding sickening odor, having a sediment of lumpy flakes almost black, and one-half inch in depth.

We compare some of the results of the analysis :

TABLE.

The numbers express parts, by weight per million parts of water, by weight.

	Organic and volatile matters : including animal and vegetable matters.	Mineral matters.
Moshassuck river pond above Sayles' bleachery.....	20.	46.
Moshassuck river below Sayles' bleachery....	483.	737.

That the great increase in the amounts of impurities indicate a strong defilement of the water, is very apparent.

23d Point Inspected.

At Sayles' pond, above Sayles' bleachery, the water appeared to be clear.

Water sample No. 11, of July 26, was taken from Sayles' pond.

This sample of water was sent to Professor Appleton for analysis. In his report in the appendix, he speaks of it as but very slightly colored. In Dr. Snow's report of November 22nd, 1877, (City Document, No. 23, already referred to), we have certain results of analyses which we introduce into this table, for purposes of comparison :

TABLE.

The numbers express parts, by weight per million parts of water, by weight.

	Organic and volatile matters, including animal and vegetable matters.	Mineral Matters.
Above Sayles' bleachery, Aug., 1877.....	23.	31.
Pawtuxet river, Aug., 1877.....	24.	24.
Above Sayles' bleachery, July, 1883.....	20.	46.

WEST RIVER.

The committee visited the West river on two occasions, that is, July 26, and August 7, 1883.

24th Point Inspected.

Silver Spring Bleachery.

Treasurer, Charles Warren Lippitt.

Location, on the West river near Charles street.

Kind of business, bleaching, dyeing and finishing of cotton goods.

The committee observed two different streams of waste liquors flowing from these works. The one was inky black ; the other was creamy and appeared to be charged with starch or some similar material.

Water sample No. 7, of July 26, was taken from the river after it had been used in the dye-house.

This sample of water was sent to Professor Appleton for analysis. In his report in the appendix he speaks of it as being straw colored and having a sediment of jet black color one-half inch in depth.

A portion of the results of analysis are given in the table below :

TABLE.

The numbers express parts, by weight per million parts of water, by weight.		
	Organic and volatile matters : including animal and vegeta- ble matters.	Mineral matters.
West River, Geneva Pond.....	16.	33.
West River, below Silver Spring bleachery.....	542.	340.

That the great increase in the amounts of impurities indicate a strong defilement of the water will hardly be denied.

Water sample No. 8, of July 26, was taken from the West river, west of the railroad bridge, below the Silver Spring bleachery.

Water sample No. 9, of July 26, was taken as the water flows from the Silver Spring bleachery stream as it enters the West river about forty feet above the railroad bridge.

Water sample No. 10, of July 26, was taken from the West river on the northern side of the Charles street bridge.

25th Point Inspected.

Wanskuck mills.

Agent, Jesse Metcalf.

Location, at Wanskuck near Branch avenue, and on the West river.

Kind of business, the scouring of wool, and the dyeing and manufacture of goods from it.

An examination was made of the new reservoirs of the Wanskuck mills used for settling the refuse liquors. These reservoirs are situated just off Woodward road, and consist of three series of large vats of two each. The refuse matter is pumped from the mills and, after leaching through the six vats, runs into a drain, thence flowing across a field for nearly a mile, finally making its way into Wanskuck pond.

Water sample No. 6, of August 7, was taken from Wanskuck reservoir.

Water sample No. 7, of August 7, was taken from the drain about three-quarters of a mile from the reservoir.

26th Point Inspected.

Tripe works of Lewis Woodward.

The committee believe that practically all of the refuse matters are carted away and sold for manuring purposes.

Water sample No. 8, of August 7, was taken from the river below these Tripe works.

27th Point Inspected.

Geneva worsted mills.

Treasurer, Albert A. Sack.

Location, on the West river at Geneva, near Douglass avenue.

Kind of business, spinning, weaving, dyeing and finishing of worsted goods.

Water sample No. 4, of August 7, was taken from the outlet of the mill-drain where it runs into the West river, and while the dye vats were being emptied.

Water sample No. 5, of August 7, was taken from Geneva pond, on the west side of the bridge, near the Geneva mills.

This sample of water was sent to Professor Appleton for analysis. From his report in the appendix we select two of the principal data respecting this sample, and compare these

with corresponding ones, referring to the Moshassuck river above Sayles' bleachery. This comparison shows that the Moshassuck river and West river, above the points where they are polluted, are of approximately similar character.

TABLE.

The numbers express parts, by weight per million parts of water, by weight.		
	Organic and volatile matters : including animal and vegetable matters	Mineral matters.
Moshassuck river, above Sayles' bleachery.....	20.	46.
West river, Geneva pond.....	16.	33.

WOONASQUATUCKET RIVER.

The committee visited the Woonasquatucket river on two occasions, that is, on July 31 and August 7, 1883.

28th Point Inspected.

This is Keily Brothers brewery.

The committee were informed that the malt and hops used at the brewery were sold for manure ; and further, that the only refuse matter emptied into the Woonasquatucket river was the water used in washing empty beer barrels. The committee observed a stream of impure water running from this brewery about four hundred feet north of Harris avenue, and they believe that it produced the very offensive odor which prevailed at that time in that neighborhood.

Water sample No. 12, of July 31, was taken from this drain.

29th Point Inspected.

This is Burnside bridge, so called, near the Locomotive Works.

Water sample No. 10, of July 31, was taken here.

Water sample No. 11, of July 31, was taken from this bridge about the middle of the river.

30th Point Inspected.

Eagle street bridge.

At this point there empties into the river a sewer, used to discharge the refuse liquors from the Weybosset Mills, and the Atlantic mills, all situated further up the stream.

The committee was informed by Mr. Charles D. Owen, of the Atlantic mills, that a number of private property owners on the line of this sewer had connected with it without permission, and were discharging house waste into it. When the committee inspected the mouth of this sewer, a large amount of foul water was flowing from it into the Woonasquatucket river.

Water sample No. 3, of August 7, and water sample No. 9, of July 31, were taken from the Woonasquatucket river, just below Eagle bridge.

Water sample No. 8, of July 31, was taken from the river at Eagle street bridge.

Water sample No. 9, of July 31, was taken from the river just below this bridge.

Water sample No. 2, of August 7, was taken from the river just below the Eagle street bridge.

This sample of water was sent to Professor Appleton for analysis, and the results he obtained are given in his report. From this report we have taken some of the results as in the other cases. As no sample of water from the Woonasquatucket river *from a point above polluting influences* was sent to him for examination, we compare the results

obtained by analysis of the sample from below Eagle street bridge, with the results from the Moshassuck river and West river at points where they are pure. The numbers point to indubitable pollution of the Woonasquatucket river at this point.

TABLE.

The numbers express parts, per weight per million parts of water, by weight.

	Organic and volatile matter: including animal and vegetable matter.	Mineral matters.
Moshassuck river, above Sayles' bleachery.....	20.	46.
West river, Geneva pond.....	16.	83.
Woonasquatucket river, below Eagle street bridge.....	291.	218.

31st Point Inspected.

Woonasquatucket Print Works.

Owners, Richmond Manufacturing Co.

Location, Valley street.

Kind of business, cotton bleaching and calico printing.

In the yard of their works the committee saw a large catch-basin for the purpose of retaining waste dye woods, etc., and preventing their entering into the stream. From this basin a drain leads the liquid matters to the river.

32d Point Inspected.

Valley Worsted mill.

Treasurer, William J. Cross.

Location, Eagle street.

Kind of business, spinning and dyeing of worsted yarn.

The dye vats were being emptied just as the committee arrived, and near the outlet of the river the stream was colored for twenty or thirty yards of a deep magenta color. The privies overhang the river.

Water sample No. 1, of August 7, was taken from the river near the outlet of these drains.

33d Point Inspected.

Providence worsted mill.

Proprietor, Charles Fletcher.

Location, Valley street.

Kind of business, manufacture and dyeing of worsted goods.

The privies from this establishment empty into the river. The refuse dye material runs into a large tank beneath the dye-house; thence it is run into the river at night.

Water sample No. 7, of July 31, was taken from this tank.

34th Point Inspected.

Providence Dyeing & Bleaching Co.

Agent, Nathan H. Baker.

Location, on the Woonasquatucket river, near Valley street.

Number of persons employed, 650.

Kind of business, dyeing and finishing of cotton goods.

Refuse material from this establishment is emptied into the river.

35th Point Inspected.

Atlantic mills.

Agents, Owen Bros.

Location, Manton avenue.

Mr. Charles D. Owen informed the committee that at this point only the exhaust steam from the engine flowed into the

river from these mills. All the sewage and waste matter is emptied into a large sewer owned jointly by the Atlantic mills and the Weybosset mills. This sewer empties into the Woonasquatucket river, under the Eagle street bridge. (This sewer is already referred to as Point 30.)

Water sample No. 6, of July 31, was taken from the river at the Delaine street east bridge.

36th Point Inspected.

Union Railroad Co.'s stables in Olneyville.

The water from the river backs up into the cellar of these stables. Between 280 and 300 horses are kept here, and the urine and waste water from them run into the river.

Water sample No. 5, of July 31, was taken from the Woonasquatucket river at the west line of Tar bridge in Olneyville.

37th Point Inspected.

Mill of the Dyerville Manufacturing Co.

Agent, Amos N. Beckwith.

Location, on Manton avenue.

Number of persons employed, 200.

Kind of business, spinning and weaving of cotton goods.

All the water closets empty into the river. At the time of inspection however the water appeared clear.

Water sample No. 1, of July 31, was taken from the river about eighty-five feet below this mill.

38th Point Inspected.

Allendale mill.

Owners, Allendale Manufacturing Co. William D. Ely,
President.

Number of persons employed, 175.

Kind of business, spinning and weaving of cotton goods.
All the privies empty into the river.

Water sample No. 2, of July 31, was taken from the river about one hundred feet below this mill.

39th Point Inspected.

Works of the Franklin Manufacturing Co., and the Union mills.

At the latter place privies used by one hundred and fifty employes empty into the river.

40th Point Inspected.

Merinville Manufacturing Co.

The water closets from this mill empty into the river.

Water sample No. 4, of July 31, was taken from the river about one hundred and forty feet below this mill.

41st Point Inspected.

The committee visited the Georgiaville reservoir, where the water appeared to be in its natural condition and free from pollution.

Water sample No. 3, of July 31, was taken from this reservoir near the dam.

CONCLUSIONS.

From the consideration that as a committee we have given the matter referred to us, we have reached the following conclusions :

First. The subject of the pollution of the waters of the Cove Basin, and thence of the Providence river, is one of great magnitude, and it is one that affects large manufacturing interests.

Second. The committee find that the objectionable condition of the waters of the Cove basin and Providence river arises from the filth that is allowed to flow into and pollute them. This filth, as we have shown, flows in abundant streams from the West river, the Moshassuck river and the Woonasquatucket river. In the case of the Moshassuck, at least, it is plain that the impurities introduced into the stream are not removed by deposition, or by any other natural influences, before they reach the Cove. For Professor Appleton finds that the foulest sample sent to him for analysis was that taken at the mouth of the Moshassuck river, where it enters the Cove basin.

If the city government shall insist that these rivers shall be allowed to flow into and through the city in a clear and pure condition and shall take such steps as will procure this end a most valuable result will be secured. In order to bring back this state of things which once distinctly existed here, not only must continued defilement of the rivers flowing into the Cove basin and Providence river be stopped, but, moreover, the beds of the rivers should be so far cleaned as the foul materials accumulated there from past pollutions shall make necessary.

Third. We detect a considerable source of pollution from out-houses, privies and similar nuisances connected with private estates. We believe that these will be dealt with by the health officers of the city.

Fourth. Another important source of defilement is referable to large manufacturing establishments. We believe that the city of Providence has clearly the right to demand of these corporations that they shall not pollute the waters flowing within the city limits to the Cove basin and thence to the Providence river. We believe that it is possible for

each one of these manufacturing concerns to purify, by filtration or otherwise, its foul liquors : —in fact our investigations have shown us that many of them are doing something in this direction. We do not think that the purification of any foul water can be called an impossibility ; it is merely a question of cost.

Fifth. We are assured by the city engineer that the adoption of any plan for the final disposition of the sewage of the city of Providence will involve the construction of marginal or intercepting sewers ; we are of the opinion that immediate steps leading to such construction should be taken.

The committee therefore recommend :

1st. That measures be taken to prevent the polluting, from outside the city limits, of the streams flowing into the city.

2d. That measures be taken to prevent the pollution of streams from points within the city limits.

3d. That such legislation shall be invoked as may be necessary to assure to the city that the water from these several rivers flowing into the city shall be free from everything offensive to smell or deleterious to the public health.

4th. That action be had looking to the immediate construction of marginal or intercepting sewers.

And also recommend the passage of the accompanying resolution, viz. :

RESOLVED, That the city solicitor be, and he is, hereby instructed to apply to the General Assembly at its next January session for such legislation as may be necessary to prevent the pollution of streams flowing into and through the city and otherwise to carry into effect the recommenda-

tions of the joint standing committee on the city engineer's department, submitted December 17th, 1883.

Respectfully submitted,

WILLIAM S. HAYWARD,
Mayor and Chairman.

GILBERT F. ROBBINS,
President of Board of Aldermen.

J. CARTER BROWN WOODS,
President of Common Council.

JAMES G. WHITEHOUSE,
Chairman Committee on Highways.

THOMAS A. MILLETT,
Chairman Committee on Sewers.

JAMES McNALLY,
Member of the Common Council.

Joint Standing Committee on City Engineer's Department.

APPENDIX.

REPORT OF JOHN HOWARD APPLETON

Professor of Chemistry in Brown University.

PROVIDENCE, Dec. 13, 1881

HON. WM. S. HAYWARD, MAYOR, ETC. :

DEAR SIR :—I enclose herewith a tabular statement of results of my tests of several samples of water sent to me for examination by the committee of City Engineer's department.

The numerical amounts shown, together with the descriptive statements of the condition of the various samples, show beyond a question that at certain points the Moshassuck river, the West River, and the Woonasquatucket river, subjected to very serious defilement. The amount of defilement is not likely to be the same at all times, at a given point. It is the custom of manufacturing establishments to discharge their waste liquors in considerable amounts at certain times, separated often by considerable intervals.

It is evident, however, that as the result of the pollution of the rivers mentioned, and at the time when inspected by the committee, the waters were in many places very foul in appearance and in odor.

I ought to remark of sample No. 5, of July 26th, that the bottle was fractured in transportation, and a portion of contents was lost. This vitiates the complete accuracy of the numerical results reported in this particular case; it does not invalidate the declaration that the water of sample was very foul.

I remain,

Yours very respectfully,

JOHN HOWARD APPLETON

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<p>“ River, north side of Whelden st. (No 5, July 26.) [Sample partly lost by breakage of bottle.]</p> <p>“ Mouth of river at Cove, No. 1, July 26.)</p>	<p>583.</p>	<p>13.</p>	<p>52.</p>	<p>195.</p>	<p>31.7</p>	<p>445.3</p>	<p>1320.</p>
	<p>356.</p>	<p>45.</p>	<p>35.</p>	<p>84.8</p>		<p>357.2</p>	<p>878.</p>
	<p>735.</p>	<p>21.</p>	<p>27.8</p>	<p>122.</p>	<p>261.</p>	<p>4011.2</p>	<p>5178.</p>
<p>West River.</p>							
<p>“ Geneva pond, west side of bridge, above Geneva Mills, (No. 5, Aug. 7.)</p>	<p>16.</p>	<p>5.</p>	<p>1.</p>	<p>5.</p>		<p>22.</p>	<p>49.</p>
<p>“ From Silver Spring bleachery, (No. 7, July 26,) as it comes from works; west side of swamp</p>	<p>542.</p>	<p>56.</p>	<p>18.</p>	<p>63.</p>		<p>203.</p>	<p>882.</p>
<p>Woonasquatucket River.</p>							
<p>From river just below Eagle street bridge, (No. 2, Aug. 7.)</p>	<p>291.</p>	<p>33.5</p>	<p>31.</p>	<p>9.</p>		<p>144.5</p>	<p>509.</p>

